THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXIX. No. 712.] LONDON, JANUARY 2, 1877. [29TH YEAR.] Price 6d.

RAMSAY'S NEWCASTLE CANNEL COAL. Analysis—12,000 cubic feet of gas per ton of coal; 28-candle gas; coke, 66·70 per cent.; volatile matters, 33·30 per cent. Coke of good quality.

RAMSAY'S PATENT CONDENSED GARESFIELD COKE.

RAMSAY'S ORDINARY GARESFIELD COKE.

RAMSAY'S FIRE-CLAY ARTICLES.

GAS-RETORTS, introduced 1828. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES, CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.

Manufactories—Derwentaugh, Swalwell, and Hebburn Quay, near Newcastle-on-Tyne.

Address G. H. RAMSAY, NEWCASTLE-ON-TYNE.
London, at the Lombard Exchange, 39, LOMBARD ST., E.C.

GENUINE TORBAY PAINT
AND
SPECIAL GASOMETER PAINT.

FOUR PRIZE MEDALS. ESTABLISHED OVER 20 YEARS.

These Paints are now used in 150 Country Gas-Works, and by all the London Gas Companies, on Gasholders, Scrubbers, Purifiers, &c. They will cover tar effectually. Also used by the Admiralty, War Office, Railway Companies, Founders, &c.

They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations.

The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov.* 2, 1866.

STEVENS & CO.,
(SUCCESSORS TO SAMUEL CALLEY.)
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WORKS: BRIXHAM, TORBAY.

THOMAS PROUD,
BROOKFIELD WORKS,
103, ICKNIELD STREET EAST, BIRMINGHAM,
MANUFACTURER OF
WOOD GRIDS
FOR
SCRUBBERS & PURIFIERS.
CONTRACTOR FOR
LAYING MAINS & ERECTING APPARATUS.
Light Steel Charging Coal and Coke Shovels, Charging Scoops, &c., &c., supplied promptly.

COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
BLAYDON BURN, BLAYDON-ON-TYNE.

Were the only parties to whom a PRIZE MEDAL was awarded at the GREAT EXHIBITION of 1851, for "GAS-RETORTS and OTHER OBJECTS in FIRE-CLAY," and they were also awarded at the INTERNATIONAL EXHIBITION of 1862, the PRIZE MEDAL for "GAS-RETORTS, FIRE-BRICKS, &c., for EXCELLENCE of QUALITY."

J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.

COWEN'S GARESFIELD COALS.
Coal Office,
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JOS. COWEN & Co. are the only Manufacturers of FIRE-BRICKS and CLAY RETORTS at BLAYDON BURN.

JOHN RUSSELL AND CO.,
LIMITED,
THE WEDNESBURY TUBE-WORKS, WEDNESBURY;
AND
THE ALMA WORKS, WALSALL.
Established at the commencement of Gas Lighting.

WAREHOUSES:
69, UPPER THAMES STREET;
COMMERCIAL STREET, SPITALFIELDS;
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J. R. & Co., Ld., are the original manufacturers of Wrought-Iron Gas Tubes and Fittings, and Inventors of the LAP-WELDED TUBES for Locomotive and Marine Boilers.

J. R. & Co., Ld., make all kinds of Tubes and Fittings for Gas, Steam, and Water; Gun-Metal Cocks, Stocks, and Dies; Galvanized Tubes and High-Pressure Tubes, &c.

Lists may be obtained on application to
69, UPPER THAMES STREET, LONDON.

JOHN BENT & SON,
BELL BARN ROAD, BIRMINGHAM,
MANUFACTURERS OF
WET AND DRY GAS-METERS,
OF
FIRST-CLASS MATERIALS & WORKMANSHIP;
ALSO, STATION-METERS, PRESSURE-GAUGES, STREET-LAMPS, REGULATORS, &c.

ESTABLISHED 1830.

THOMAS PIGGOTT & CO.,
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MANUFACTURERS OF
TELESCOPIC & SINGLE GASHOLDERS,
CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.
SUGAR, SALTPETRE, AND ALL KINDS OF PANS.
Roofs, Girders, and Bridges, and General Smith's Work.
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J. & H. ROBUS,
BUILDERS AND CONTRACTORS
FOR THE
ERECTION AND REBUILDING OF GAS AND WATER WORKS.
ESTIMATES FREE
FOR MAIN-LAYING AND GENERAL REPAIRS.

RETORT-SETTING A SPÉCIALITÉ.

ROBUS'S IMPROVED RETORT-SETTINGS guaranteed to carbonize a large amount of coal with a small per cent. of fuel.

N.B.—All kinds of Fire Goods, &c., kept in stock for immediate delivery. Orders promptly attended to.

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DUKE OF HAMILTON'S
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GEORGE GLOVER & CO.

PATENTEES OF THE

NATIONAL STANDARD GASOMETERS

FOR THE ENGLISH GOVERNMENT
AND FOR THE GOVERNMENT OF THE NETHERLANDS
AND OF THE DUPLICATE COPY
Presented by Her Majesty's Government to the French Government,
AND MANUFACTURERS OF
IMPROVED DRY GAS-METERS
Warranted to Measure correctly & not to vary.

RANELAGH WORKS, RANELAGH ROAD, PIMLICO, LONDON, S.W.
236, GEORGE STREET, GLASGOW, & 30, LANCASTER AVENUE, MANCHESTER.

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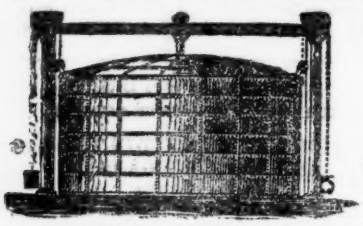
WELLINGTON TUBE-WORKS, TIPTON, STAFFORDSHIRE,

MANUFACTURER OF

EVERY DESCRIPTION OF TUBING, GAS, STEAM, HYDRAULIC TUBES AND FITTINGS,
EITHER BLACK, GALVANIZED, OR ENAMELLED HOT WATER TUBES AND FITTINGS,
CORE BARS, COILS, COCKS (IRON OR BRASS),
CHANDELIERS, &c., GAS-FITTERS' TOOLS, GAS TONGS, STOCKS, TAPS, DIES, &c., &c.,
HANDRAIL TUBINGS, IRON AND BRASS, PLAIN OR TWISTED,
TELEGRAPH TUBES OR POLES, &c., &c.

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS



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WHITESTONE IRON-WORKS, HUDDERSFIELD

MANUFACTURERS OF

RETORTS, ANNULAR AND PIPE CONDENSERS,
WROUGHT AND CAST IRON SCRUBBERS, PURIFIERS,
GASHOLDERS,

GOVERNORS, AND ALL THE NECESSARY FITTINGS FOR COMPLETING THE ERECTION OF GAS-WORKS.

STATION & CONSUMERS WET OR DRY METERS, STREET & SERVICE MAINS, LAMP COLUMNS & BRACKETS, & WROUGHT-IRON TUBES AND FITTINGS; WROUGHT-IRON ROOFS FOR ANY SIZE OF BUILDINGS.

Sole Makers of B. W. Thurston's Combined Condensing, Scrubbing, and Washing Apparatus,
AND PATENTEES OF THE IMPROVED COMBINED CONDENSING AND PURIFYING APPARATUS SO EMINENTLY ADAPTED FOR EXPORTATION.

REFERENCES TO UPWARDS OF 300 GAS-WORKS.

LONDON OFFICES: 92, CANNON STREET.

WEST'S GAS IMPROVEMENT COMPANY,

LIMITED,

ARE NOW PREPARED TO SUPPLY AND ERECT THEIR PATENTED MACHINERY FOR

CHARGING AND DRAWING GAS-RETORTS,

And to enter into arrangements with GAS COMPANIES for its use upon moderate terms of Royalty.

The Patented Machinery has secured the approbation of all Engineers who have visited the MAIDSTONE GAS-WORKS, *where it is in full operation, and may be inspected at any time on application to the Manager.*

The advantages attending its use are—

INCREASED VOLUME OF GAS PER TON.—INCREASED YIELD PER RETORT.—INCREASED BULK OF COKE FOR SALE.—REDUCTION IN LABOUR AND LESS DEPENDENCE ON SKILLED STOKERS.

A Pamphlet containing a description of the Machinery, and Copies of Reports on the working of the same, &c., will be forwarded on application to the MANAGING DIRECTOR, Maidstone. Communications may also be addressed to the Consulting Engineer, R. P. SPICE, Esq., M. Inst. C.E., 21, Parliament Street, London, S.W., or to the Engineer and Analyst, F. W. HARTLEY, Esq., A. Inst. C.E., 55, Millbank Street, London, S.W.

Established

1795.

JOSEPH CLIFF & SONS,

THE ORIGINAL

WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS,

London Wharf: No. 4, inside Great Northern Goods Station, King's Cross, N.;

LIVERPOOL: Back Leeds Street.

SPECIAL NOTICE.—Our Patent Machine-made Retorts have now been in *actual work* nearly 800 days, and are yet in good order. References on application.

WHITEHOUSE AND COMPANY, LIMITED,

GLOBE TUBE-WORKS, WEDNESBURY; & VICTORIA TUBE-WORKS, GREAT BRIDGE, STAFFORDSHIRE,

MANUFACTURERS OF

PATENT WELDED WROUGHT-IRON TUBES,

FOR GAS, STEAM, AND WATER;

GAS-FITTERS TOOLS, STEAM COCKS, AND ALL KINDS OF JOINTS.

HYDRAULIC TUBES, CORE BARS, TELEGRAPH POSTS, COILS, &c.

London Agent—ALFRED LAKEMAN, 9, FENCHURCH STREET, E.C.

GAS PURIFICATION & CHEMICAL Co., LIMITED.

(Successors to JOHN WILLIAM O'NEILL & CO.,)

Offices—PALMERSTON BUILDINGS, OLD BROAD STREET, LONDON, E.C.,

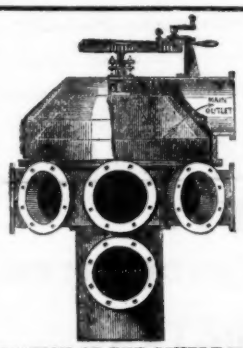
CONTRACTORS FOR GAS PURIFICATION BY OXIDE OF IRON.

The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.

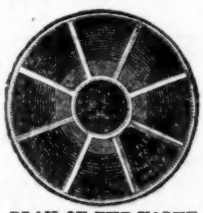
JOHN WILLIAM O'NEILL, SAMUEL H. JOHNSON. } Joint Managing Directors.

C. & W. WALKERS'

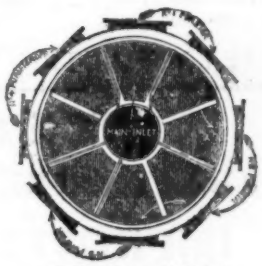
PATENT CENTRE-VALVES.



ELEVATION OF THE CENTRE-VALVE.



PLAN OF THE VALVE.



PLAN OF THE BODY.

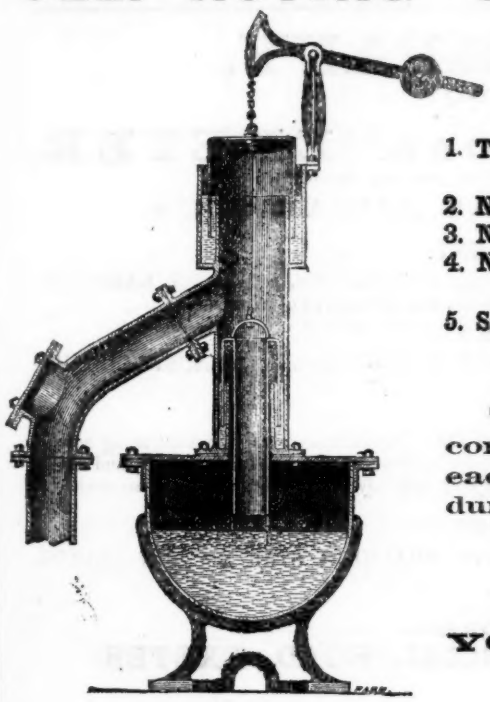
These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

MIDLAND IRON-WORKS. DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

SELF-ACTING REMOVABLE DIP-PIPE,

PATENTED BY

CHANDLER & STEVENSON.



ADVANTAGES.

1. There is no pressure on the Retorts.
2. No deposit of Carbon.
3. No scurfing is required.
4. Never a choked Ascension-Pipe.
5. Saves Fuel and Wear and Tear.
6. Gets 10 per cent. more Gas out of the Coal, and a higher Illuminating Power.
7. Is never out of order.
8. Requires no attention.
9. Is perfectly automatic in its action.

These Dip-Pipes can now be supplied complete, except the flanched bend, for £4 each, which includes the charge for licence during the whole term of the patent.

Applications to be made to

Messrs. CHANDLER & SONS,

YORK STREET, LONDON ROAD,

SOUTHWARK.

THE

IMPERIAL METER COMPANY,

LIMITED,

KING'S ROAD, LONDON, N.W.,

OFFICE: 115, VICTORIA STREET, WESTMINSTER, S.W.,

MANUFACTURERS OF

"WET" & "DRY" GAS-METERS IN IRON & TIN-PLATE CASES,

STATION-METERS AND GOVERNORS, STREET-LAMP METERS, BOXES, AND

REGULATORS FOR THE AVERAGE METER SYSTEM.

Attention is called to their Dry Meters in Wood Cases, as used by the principal London Gas Companies. These Meters are especially suitable for seaport towns and for export.

The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's Patent.

EDWARD E. CROMBIE & CO.,

INVENTORS AND PATENTEES

OF THE

FRICTIONLESS DRY GAS-METERS,

Beg to intimate to Gas Companies and others that they are now prepared to supply these very superior Meters at the same prices as for the ordinary Gas-Meters.

In the construction of this Meter, for which the best tin plates only are used, every mechanical contrivance has been taken advantage of successfully to reduce the friction to a minimum, which is amply proved by the fact that they are made to work upon only one-fortieth of an inch pressure. By an improvement also in their construction, a steadier light is obtained, and greater capacity than can be got from any other Meter in the market. No gas can pass under the valves on any back pressure, as is the case with many other Dry Meters.

To Gas Companies supplying gas through streets with heavy gradients, these Meters are invaluable, as much gas is saved from the low pressure required to work them.

ALL METERS ARE UPHELD FOR FIVE YEARS.

METROPOLITAN WORKS, DIANA PLACE, EUSTON ROAD, LONDON, N.W.

FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER;

Manufacturers of

IMPROVED CONSUMERS WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

AND

IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

GOVERNORS, PRESSURE AND EXHAUST REGISTERS, TEST HOLDERS.

And all kinds of Experimental Gas Apparatus.

WILLEY & COMPANY,

GAS ENGINEERS,

WORKS: COMMERCIAL ROAD, EXETER,

INVITE THE ATTENTION OF GAS COMPANIES AND OTHERS FOR THE SUPPLY OF

EVERY DESCRIPTION OF GAS APPARATUS.

ENGINEERING DEPARTMENT.

NEW GAS-WORKS erected complete. Plans and Estimates furnished. MAINS, METERS, SERVICES, LAMPS, &c., adapted for Towns of any size. Gas Companies advised on Improvements, Extensions, and Alterations of Works.

GASHOLDERS AND TANKS.

RETORTS and RETORT-HOUSE FITTINGS, CONDENSERS, SCRUBBERS, ENGINES and EXHAUSTERS, PURIFIERS, STATION-METERS, GOVERNORS, VALVES, &c.

METER DEPARTMENT.

They beg special attention to the excellence and superiority of their WET and DRY METERS, several thousand being now in use by many of the largest Gas Companies in the West of England and South Wales. Warranted to measure correctly, and not to vary. Their acknowledged superiority has brought them into general use more rapidly than any Meters hitherto manufactured. A guarantee of Five years tendered with each Meter.

GAS-FITTING DEPARTMENT.

An extensive variety of Choice Designs in CHANDELIERS, PENDANTS, BRACKETS, STAR and SUN LIGHTS, MEDIÆVAL FITTINGS for CHURCHES, &c.

PATTERN-BOOKS and PRICE LISTS furnished.

☞ PLEASE NOTE THE ADDRESS—

GAS ENGINEERING WORKS, COMMERCIAL ROAD, EXETER.

MESSRS. NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD,

MANUFACTURERS OF

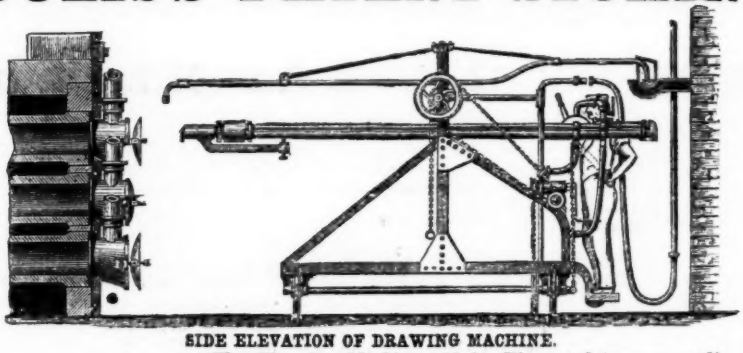
IMPROVED CENTRE-VALVES,

PURIFIERS, CONDENSERS, SCRUBBERS, GASHOLDERS, ROOFS,

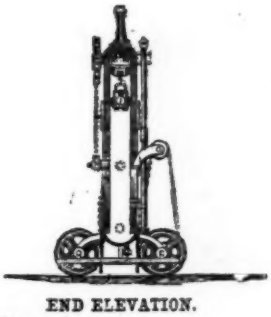
And every description of Gas Machinery.

TENDERS GIVEN FOR WORK FIXED COMPLETE IN ANY PART OF THE KINGDOM.

FOULIS'S PATENT STOKING MACHINE.



SIDE ELEVATION OF DRAWING MACHINE.



END ELEVATION.

(The Charging Machine will be Illustrated in next week's Advertisement.)

Makers: **TANGYE BROTHERS and HOLMAN**, London and Birmingham; **ADAM WOODWARD and SON**, Manchester; **ROBERT LAIDLAW and SON**, Glasgow; **MASCHINENBAU-ACTIEN-GESELLSCHAFT HUMBOLDT**, Kalk bei Deutz:
Or all particulars may be had from **JAMES WOTHERSPOON**, 31, St. Vincent Place, Glasgow.

THOMAS ALLAN & SONS,

IRONFOUNDERS,

WORKS:

SPRINGBANK FOUNDRY & NORTH WOODSIDE FOUNDRY,

GLASGOW;

BONLEA FOUNDRY, STOCKTON-ON-TEES,

Manufacturers of

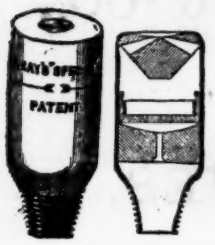
CAST-IRON GAS AND WATER PIPES.

SIZES: ¾ to 12 inches at GLASGOW.
„ 1½ to 7 „ STOCKTON.

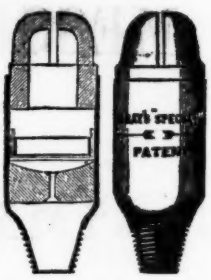
A LARGE STOCK KEPT, AND PRICES MODERATE.

Freight to London, in the Stream, 10s. per ton from Stockton; 12s. 6d. from Glasgow.

London Agent: Mr. A. C. FRASER, ST. STEPHEN'S CHAMBERS, TELEGRAPH STREET.



BRAY'S
NEW
GAS-BURNERS.



BRAY'S "SPECIAL"
TRADE MARK.
PATENT.

A NEW FEATURE IN GAS LIGHTING.

OUR WELL-KNOWN

PATENT "ENAMEL" REGULATOR GAS-BURNERS

(UNION JETS AND BAT'S-WINGS)

Were designed as improvements on the common Burners, and that object has been so successfully attained that they have, we believe, met with more approval and recommendation from the Gas Engineering Profession and the Public than have been accorded to any other firm's make of Burners since the commencement of gas lighting.

Of the two kinds of Burners—the Union Jet and Bat's-wing—in general use, the latter is the least useful, because of its want of adaptability to general circumstances, and great liability to get out of order; but, when in good order, it has hitherto had the advantage of yielding more light with common and medium qualities of gas than the Union Jet. The Union Jet, on the other hand, has the advantage of greater adaptability, being useful everywhere, is less liable to get out of order, requires scarcely any attention, and will stand more rough usage. Notwithstanding these great practical advantages, which are almost everything in a Gas-Burner, Gas-Burner improvers have been attracted to the Bat's-wing, because of its giving a more showy result when tested for illuminating power only.

We have succeeded in improving both Bat's-wing and Union Jet Burners; but, while adding materially to the efficiency of the first-named, it is specially noteworthy that the Union Jet has received most advancement by these improvements. While retaining all the advantages of the Union Jet, we have brought it up in ILLUMINATING POWER to the level of the most expensive Bat's-wings specially got up for developing that feature. The result is such that we have no hesitation in pronouncing BRAY'S "SPECIAL" UNION JET

THE BEST BURNER HITHERTO PRODUCED,

AND

A NEW FEATURE IN GAS LIGHTING.

The leading features of this NEW UNION JET may be summarized as follows:—

It gives more light, from the smallest to the largest sizes, than any Union Jet was ever before known to give.

It gives 30 to 60 per cent. more light than the common Union Jets, and 15 to 20 per cent. more than our own much commended Patent "Enamel" Union Jet.

It gives as much light as the most expensive Bat's-wings specially constructed for high illuminating power, without the Bat's-wing's disadvantages.

Tested on the Photometer at various consumptions—say, 3, 4, and 5 feet of Gas per Hour, or any similar variation—and the results averaged, our New Burner will show a higher illuminating power than the best Argand. If the tests are made downwards and upwards as well as laterally, the results will be still more in favour of our New Burner.

ADDITIONAL ADVANTAGES possessed by our NEW BURNER over all others in the market, and these are applicable and are added to our IMPROVED BAT'S-WING:—

In all Burners having an arrangement for diminishing the flow of Gas before it arrives at the point of ignition, that part of the Burner which effects this object has been a source of weakness, because of its being placed in a position very liable to fracture, and easily tampered with. Indeed, this is so arranged that any one can get at and break or widen out the inlet for the Gas at pleasure, and make what ought to be an economical Burner a most extravagant one. In our New Burner, this part is so hard that it cannot be enlarged by drilling, and is so arranged that it cannot be otherwise tampered with without breaking up the whole Burner; this forming, we believe, the most efficient safeguard yet introduced against the extravagant use of Gas by those who have not to pay for it.

The Gas Supply being given through one ROUND hole, which is made through non-corrosive material, it is not so liable to stop up or get out of order as in cases where a number of small holes or narrow slits are used. When these holes are made through *metal*, the lasting property of the Burner so constructed is almost *nil*, even if the aperture is not tampered with.

There is no hissing noise caused by the passage of Gas through the diminishing arrangement of this Burner.

☞ All our "Special" Burners have our Trade Mark stamped on the sockets thus BRAY'S "SPECIAL" PATENT.

GEORGE BRAY & CO., BLACKMAN LANE, LEEDS.

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

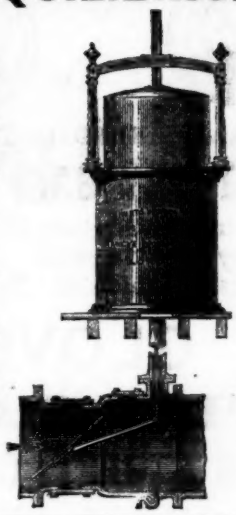
Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at any convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.



These Governors have been adopted by many leading Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Birmingham, Cannes (France), Devonport, Dursley, Exeter, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1875.

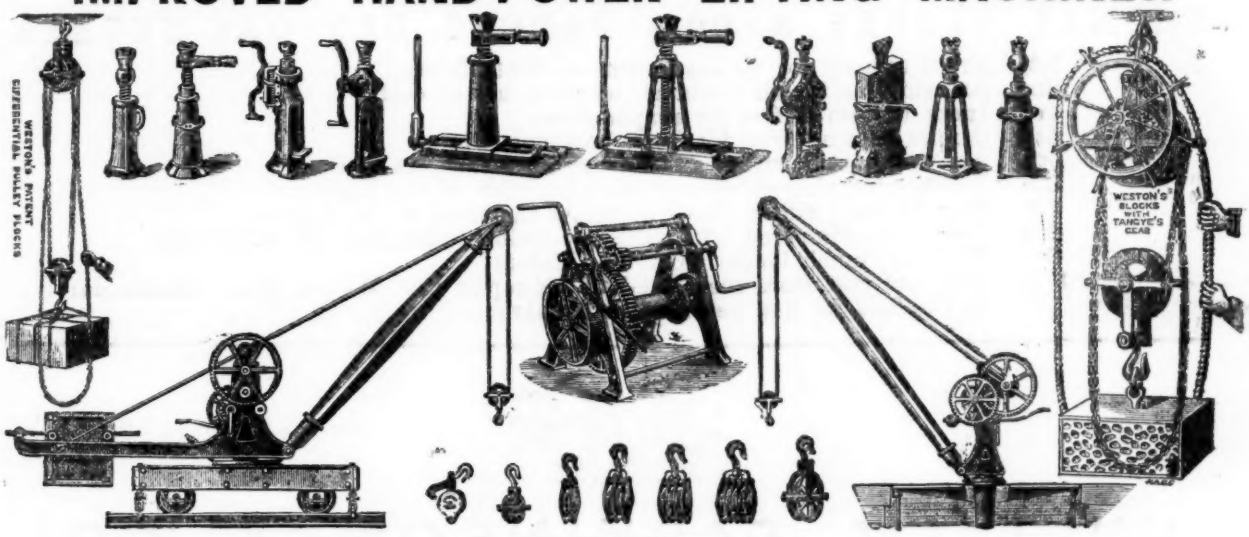
MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

Yours truly,

(Signed) JOHN JOHNSON.

IMPROVED HAND-POWER LIFTING MACHINES.



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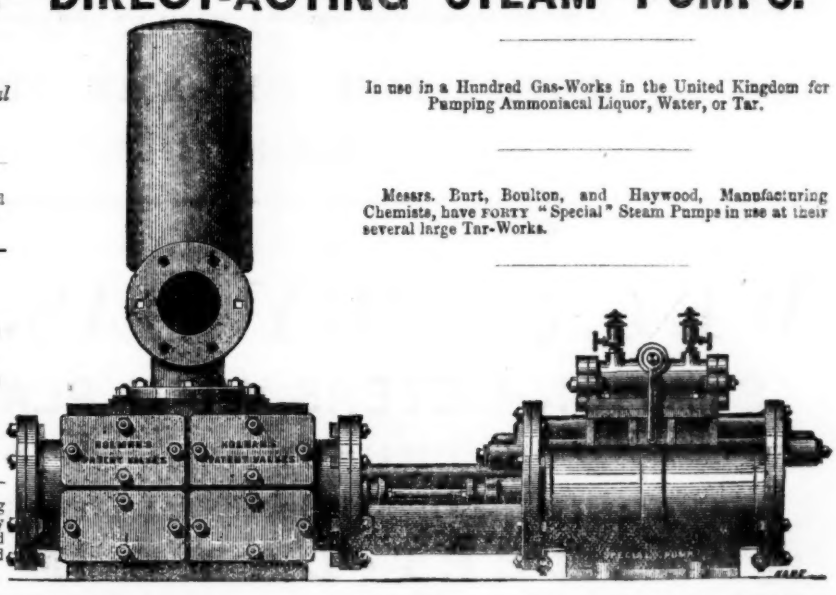
The following are a few of the leading Sizes in use in Gas-Works and Chemical Works:—

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4*	2	9	815	18
3	3	9	1,830	18
5	2½	12	1,250	21
5*	3	12	1,830	22 10
4	4	12	3,250	25
6*	4	12	3,250	30
5	5	12	5,070	32 10
7*	5	12	5,070	40
6	6	12	7,330	40
8*	6	12	7,330	50
7	7	12	9,750	50
10*	7	12	9,750	65

* These sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance piece between steam and pump cylinder at a small extra cost.



In use in a Hundred Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have FORTY "Special" Steam Pumps in use at their several large Tar-Works.

TANGYE BROTHERS AND HOLMAN,

LAURENCE POUNTNEY LANE, LONDON, E.C.

London 1851. New York, 1853 Paris, 1855. London, 1862.

Dublin. 1865

The SIX MEDALS AWARDED to THOMAS GLOVER for

PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

MANUFACTURERS OF PATENT

WET & DRY GAS-METERS,

STATION-METERS WITH PLANED JOINTS,

GOVERNORS, PRESSURE REGISTERS, GAUGES,

AND EXPERIMENTAL APPARATUS,

STREET-LAMP METERS,

AND REGULATORS FOR AVERAGE METER INDICATION.

METERS FOR MEASURING WATER.

CONTENTS.

	Page
Circular to Gas Companies:—	
Prospects of the New Year	9
Proposed Legislation on the Sulphur Question	9
Report of the Gas Referees on the Alleged Nuisance at Haggerston	9
A Mode of Reviving Lime	10
Gas Affairs at Hull	10
Newcastle-under-Lyme—A Correction	10
Importation of Hartley Mineral	10
Gas Affairs in Victoria	10
The Warrington Gas Purchase	10
Water and Sanitary Notes:—	
The Sewage Report of the Local Government Board	11
The Water Supply Crisis at Richmond	11
Leading Article:—	
A Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas	11
Communicated Articles:—	
French Practice in the Construction of Gasholders. By Dr. William Pole, F.R.S., M. Inst. C.E., &c.	12
Contributions to the Theory of Luminous Flames. By Dr. Karl Keumann	14
Correspondence:—	
Quantity of Brickwork in Retort-Settings	16
The "Chameroy" Pipe-Joint	16
Miscellaneous News:—	
Sale of Gas and Water Shares	11
Water Supply of Mexborough	11
Gas Explosion at Sheffield	13
Lighting by Electricity	16
Metropolis Gas Supply	17
Metropolis Water Supply	17
Glasgow Street Lighting	17
Gloucester New Gas-Works	18
Enrichers	18
Braddock's Compensating Governor	19
On Anthracene Production. By Dr. F. Versmann	19
Water Supply of New York	20
On Street-Mains. By Mr. W. H. Price	21
The Chemical and Metal Trades in 1876	21
Trade Reports	22
Water Supply of Worsborough, Blacker Hill, and Birdwell	23
"Hartley Mineral"	23
Water Supply of Bridgwater	23
Proposed Purchase of the Stoke Gas-Works	23
Naphtha Wells	24
Crystal Palace District Gas Company	24
Register of New Patents:—	
Newton, A. V.—Liquid Meters	24
Moore, J.—Apparatus for Relieving the Pressure in Gas-Retorts	24
Vaughan, E. P. H.—Fire Alarm and Gas Intercepter	24
Palmer, J. D.—Gas-Burners	24
Lake, W. R.—Manufacture of Gas	24
Applications for Letters Patent	24
Patents which have passed the Great Seal	25
Patents which have become void	25
Share List of Metropolitan Gas and Water Companies	25

NOTICE TO SUBSCRIBERS.

Subscribers who desire to avail themselves of the reduction in the subscription to the JOURNAL by paying in advance for the year 1877, are reminded that this can only be done during January.

Vol. XXVIII. (second half of 1876) will shortly be ready, bound in cloth, gilt letters, price 18s. Cloth cases for binding may now be obtained on order from any bookseller, or from the Publisher.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

C. T. S., R..... *The publication of your first letter was unavoidably delayed, although it had been in type for some time. We shall always be glad to hear from you.*

S. E. *writes:—"Will any manager of a gas-work be kind enough to explain, if he can, a very singular accident that has just taken place in this town, happily without loss of life or property, further than the total destruction of a five-light wet-meter. The meter was fixed in a shop, below the window-sill, and there had been no frost for days to affect it, nor any fire near it. One gas-jet was burning in the shop to-day, when, without any warning whatever, a sharp report like the sound of a rifle was heard, which shook the place. As I happened to be passing within three minutes of the accident, I examined the meter, and found the breast of it blown clean off, destroying case and everything. The force of the explosion tore off the screw of the spindle of the cylinder, cutting the pin as clean as a file. The cylinder itself is torn, and bulges out, and everything destroyed except the front plate of the meter and index. I found the breast of the meter blown off, leaving 5½ inches clear space between that and the cylinder-case. The couplings and overflow-pipe were all tightly screwed up."*

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JANUARY 2, 1877.

Circular to Gas Companies.

THE prospects of the year just commenced, if not of a brilliant, may, at all events, be said to be of a cheering description. There can be little doubt that the general prosperity of all substantial gas undertakings is well assured for another twelve months. Trade is slowly reviving, but there is no chance that the present year will see such an expansion of our manufacturing industry as will raise, to any important extent, the price of our raw material, coal. Contracts will, no doubt, be made on much the same terms as last year, and thus we may expect that gas will continue cheap, while full dividends are maintained.

There are but few threatening signs. In the Metropolis all agitation against the Gas Companies has ceased. Not a word was said on the "Gas Question" at the City Wardmotes on St. Thomas's Day, and the vestries are quiet, except one or two who make small complaints about nuisances.

In the provinces also the general aspect of affairs is satisfactory. One or two Companies, it is true, will be compelled to defend in Parliament their interests against the cupidity of Local Authorities, but we shall be surprised if either suffer material wrong. We believe they will be left secure in their property, but if a compulsory sale be enforced in either case, we have no doubt at all that the justice of Parliament will award an adequate price. The Isle of Thanet Company, we feel convinced, need be under no alarm. They go to Parliament with a liberal Bill, in pursuance of a stipulation made with, or a recommendation made by, a Parliamentary Committee last session, and they are opposed by the Local Board of Ramsgate, whose desire it is to confiscate the undertaking. That these latter will not succeed, may be safely predicted, and the ratepayers of Ramsgate will again suffer in their pockets. The expenses of the Board in the next session will, probably, be four times the amount incurred in the last session, and the rates will necessarily be increased in proportion. Some ignorance would seem to prevail on both sides as to the incidence of the costs. If the Board succeed, they will have to pay the costs on both sides; if they fail, the ratepayers will have to pay those incurred by the Board. It would be well if these facts were put clearly before the inhabitants, prior to the poll being taken on the 16th inst. They seem at present to be buoyed up with a hope of success which is by no means justified, and which, if realized, would not for some years place them in a better position with respect to the gas supply than they are at present.

Returning to the Metropolis, we may notice the two Bills, one promoted by the Chartered, and the other by the Crystal Palace District Company, to relieve them of the sulphur purification difficulty. The latter Company are tied down to a maximum of twenty grains of "sulphur" in one hundred cubic feet of gas, and we believe that they have kept fairly within that limit. But of late they have experienced a difficulty in getting rid of their foul lime; and, moreover, have not been happy in the selection of a spot on which to deposit the refuse. We have had to report proceedings taken by the Lewisham Board against them for a nuisance created by the drainings from heaps of foul lime.

The Bill promoted by the Chartered Company is a very simple one. It merely proposes to repeal two clauses in the Act the Company obtained last year. Section 30 of that Act gives the Referees power to fix the maximum amount of impurity to be allowed without occasioning a nuisance in the neighbourhood of the works; and section 51 makes the Company liable to a fine of £50 if the average results of three days testings show that the maximum has been exceeded in the gas delivered from any station. The object, as in the previously mentioned case, is to get rid of the sulphur difficulty; and it must be admitted that in works situated like those at Camden Town and Haggerston, the difficulty is very serious. How far these Bills, and particularly the latter, will be opposed by the Local Authorities, remains to be seen. Public opinion seems to have undergone some change on the vexed sulphur question; but it would not be safe to infer that these proposed measures will be allowed to pass without opposition. A Gas Bill is, to a Local Authority, what a red flag is to a bull, and it is not unlikely that the Corporation of the City of London and the Metropolitan Board of Works will make a rush to toss the Bill of the Chartered Company into the air. That of the Crystal Palace District Company, we may confidently expect, will be opposed by, at least, one Local Authority, and we shall probably have the old question fought over again with considerable vivacity.

In another column, we publish the report made by the Metropolitan Gas Referees on the alleged nuisance at the Haggerston works of the Chartered Company. It would seem that the inhabitants of St. Leonard's, Shoreditch, and the neighbouring district, have suddenly become alive to the possession of olfactory nerves. Unless we are mistaken, wet lime purification was carried on at those works for very many years by the Imperial Company; and we think we remember an occasion, not very remote, when one of their purifiers burst. It is certain that such an accident, and even the simple emptying of wet lime purifiers, must have caused far worse smells than could possibly be experienced from the emptying of dry lime purifiers. But, so far as we remember, no complaints were ever made until the month of October last, by persons resident in the neighbourhood. It would seem clear, from the report of the Referees—who visited the scene some time after the complaints

were made, but who witnessed the exact operations which had been carried on, and are alleged to have occasioned the nuisance —that the offence, if it can be called an offence, is of a very limited extent. The agitation evidently does not originate with those who are more immediately exposed to the offensive gas, and the Referees are perfectly right in deciding that the complaints are destitute of foundation. We may be forgiven for holding a strong opinion that no smell that emanates from a gas-works is deleterious to health. Sulphuretted hydrogen does not possess an agreeable odour, but it has never been proved that it is injurious to health, except in a concentrated form. If it were, most analytical chemists would die in an early stage of their professional existence. What will come of the present outcry cannot be foreseen; but the Bill now promoted by the Chartered Company, if successful, will remove all the present grounds of complaint, with what consequences need not here be referred to.

While on this matter, we may once more call attention to a method described in our columns two years ago, which would seem to offer the possibility of abolishing all nuisance, while reviving the lime for repeated use. The foul mixture of sulphide of calcium and carbonate of lime has only to be carried to an oven, where it will be exposed to heat, in the presence of steam, so long as sulphuretted hydrogen is given off, and then to a current of air, which will carry away the carbonic acid, leaving at the end caustic lime in the oven, that has only to be slaked for repeated use in the purifier. The experiment is easily and quickly made, on a small scale, in the laboratory, and we see no reason why it should not succeed, with properly constructed appliances, on the largest scale. Of waste heat there is plenty in gas-works that might be utilized in heating the ovens, and every grain of sulphur might be fixed in an oxide purifier, and would go some length towards paying the expenses of the process. We cannot help thinking that it would prove highly remunerative to revive lime in this way; but the very least result would be the suppression of what some people regard as an intolerable nuisance.

Going back to the provinces, we find that a Sub-Deputy Gas Committee of the Corporation of Hull have had an interview with a Committee of the Directors of the Kingston-upon-Hull Gas Company, in order to ascertain on what terms the Company would sell their undertaking to the Corporation. The answer may be readily guessed. The Company have no desire to sell, and, therefore, asked for an offer. The Corporation had none to make, and thereupon the deputation withdrew. The Sculcoates Company, it would seem, declined to receive a deputation from the Corporation, and nothing can be done with them, unless under compulsion, which some Hull Councillors are disposed to try. Next year we may have a pretty quarrel in this quarter; and, as a preparatory step, the Gas Committee have resolved to ask all corporate towns having gas-works, for a return of the profits made, and the success of the management. The results will be satisfactory in one sense, but will hardly encourage the Corporation of Hull to attempt the compulsory purchase of the several gas undertakings within their limits. The case is peculiar. There is, we think, nothing like it, except in the Metropolis; and the obstacles in the way of a compulsory purchase are very great.

We are naturally liable to be misled by penny-a-liners, who make up sensational stories for the edification of readers of provincial prints. One such case occurred in our issue of the 19th ult., in which we made some remarks on the gas supply of Newcastle-under-Lyme. A credible correspondent informs us, that the deficiency of gas lasted only twenty-four hours, and was owing to the breakdown of an exhauster. It being full moon at the time, the public lamps were, not unwisely, extinguished, so that private consumers might have the largest possible supply.

The first reported event of the current year which presents interest to gas companies, is the arrival in the London Docks of the *Martin Luther*, with a freight of 400 tons of Hartley Mineral, or Australian Boghead. We have before referred to this Mineral, and its extraordinary gas-producing power, and a further reference to it will be found in another column. The cargo, we understand, has been purchased by the Chartered Company, and we shall shortly, no doubt, have a full account of the results obtained by its use. According to Professor Chandler, in America, and experimenters in New South Wales, from which country it is imported, the quantity of gas obtained from it, and the richness in illuminating power, far exceed that procured from the Scottish Boghead, or even the famous Nova Scotian Albertite. In view of the rapid exhaustion of our native cannel-fields, this importation becomes of vast consequence. If the supply can be kept up, and the price of the Mineral be maintained within such limits as Gas Companies can afford to meet, the demand will become very large, not only as a gas enricher, but as a material to be distilled for illuminating oils. The advanced price of American petroleum has given a considerable impetus to the production of these oils in Scotland. It is curious to note how, as the price of these rich oils rises, the schemes for manufacturing gas from them subside. We believe that there is now only one manufactory of petroleum gas in existence in the United Kingdom, and that, we rather think, has not received the extension anticipated. "Coal is King!" and on him, or it, we have still to rely for warmth and light. Petroleum oil, we know, is plentiful in the Old World as well as in the New. The Holy Wells of Baku have yielded it uninterruptedly for perhaps two thousand years, but they have never been pumped. There can be no doubt, however, that a vast store of oil exists on the shores of the Caspian, but it will be very many years before a single *pood* of it finds its way into the Thames, and in the meantime the Pennsylvanian and Canadian wells may be dried up.

From New South Wales coal or shale to Victorian gas squabbles is an easy transition. The City of Melbourne, as we have before informed our readers, is lighted with gas by three companies, two of which, at all events, are in competition in the southern districts and suburbs of the City. The Collingwood Gas Company have at present statutory power to charge 17s. 6d. per 1000 feet, and to divide 25 per cent.; but it does not appear that they have ever done either. They are now in Parliament to obtain further powers, among which is authority to raise additional capital to the amount of £600,000, and as here, when a Gas Company go to the Legislature for any fresh powers, they have to submit to new restrictions. It seems likely that a maximum price of 9s. will be imposed, and that a standard of illuminating power will be fixed. The price at present charged by the Company is 7s. 6d. Except where they are in competition with the City of Melbourne Company, it is 5s. 10d., so that 9s. would not appear to be an unfair maximum. In their last session, the Victorian Assembly passed an Act not unlike the Burghs (Scotland) Gas Supply Act, which gave Local Councils, with the consent of their constituents, power to start gas-works, when no Company furnished a supply. The Councils of St. Kilda and Prahran attempted to avail themselves of the provisions of the Act, but they were stoutly opposed by the City of Melbourne Company, who principally supply the districts, and on a poll being taken, the Municipal Councils were beaten by four to one. The shrewd ratepayers in the suburbs of Melbourne evidently do not perceive the advantage of competing municipal gas-works. Somebody prophesied an extra threepenny rate—a not unlikely result of competition—and that frightened the ratepayers.

The conditions in Melbourne, as we have said before, are not unlike those which obtain in this Metropolis, and we can only give the advice we offer at home. The circumstances of the Melbourne Companies can hardly be so diverse that they will not allow of amalgamation on fair and equal terms, and in that alone can they find full protection from the assaults of Local Authorities. Let them try it as soon as possible, and the sooner the better for both consumers and companies.

We question whether those who advocate the purchase of the Warrington gas undertaking are doing their best to promote the success of the cause they support. No amount of "chaffing" correspondence in the newspapers, or (without offence to Mr. Diggles) hireling oratory, is likely to convince the hard-headed Lancashire men that the bargain made is a good one for the town. That it is, we have no doubt whatever; and if we did not prefer to see the undertaking left in the hands of the Company, we should much regret the course adopted by some members of the Town Council. We think we may assume it as certain, that the poll about to be taken will be adverse to the design of the Council. It is not that the majority are opposed to the purchase; it is the price they object to. Now, it cannot be difficult to show by plain figures—and Mr. Spice has already demonstrated what we consider to be the fact—that the price agreed upon is reasonable, and that the prospects of the Corporation in possession of the gas-works would be of a most promising character. A certain amount of speculation is, of course, involved in such a transaction; but probabilities, and all past experience, go to show that, in growing districts, the consumption of gas goes on increasing in a pretty clearly defined ratio; and if this hold good in the case of Warrington, the Corporation must, in the course of a few years, if they acquire the gas-works, have very considerable surplus profits. This is what should be made clear to the ratepayers of Warrington, if they are to be expected to vote for the purchase.

Water and Sanitary Notes.

The report of Messrs. Rawlinson and Read, to which we alluded last week, has been published, and a hasty glance through it confirms the opinion we expressed, after reading an abstract, that it is almost entirely of a negative character. While saying this, we may at once admit that, in the main, we agree with the conclusions of the Commissioners. The report will, we have no doubt, be assailed from several quarters. Mr. Hope will, of course, contend that sewage farming must necessarily be profitable, if there be only enough sewage distributed on a farm. The Native Guano Company, who, no doubt, still continue to sell the manure they make for £3 10s. per ton—the price they have always obtained for it, whether it contain crystals of sulphate of ammonia or not—will, of course, energetically contend for the advantages of a chemical precipitation scheme, and lament over the stupidity of capitalists and the obtuseness of Local Authorities, who cannot be made to recognize the merits of their system. Alderman Taylor, too, can have little difficulty in proving that the Commissioners are wrong in their estimate of the "pail "system" at Rochdale. He will, of course, prove that commercially it is a great success, while the sanitary condition of Rochdale has been greatly improved since the system was inaugurated. All this, and much more, we expect in reply to this report, of which we here append the general conclusions arrived at by the Commissioners:—

That the scavenging, sewering, and cleansing of towns are necessary for comfort and health; and that in all cases these operations involve questions of how to remove the refuse of towns in the safest manner and at the least expense to the ratepayer. That the retention for any lengthened period of refuse and excreta in privy cesspits, or in cesspools, or at stables, cowsheds, slaughter-houses, or other places in the midst of towns, must be utterly condemned; and that none of the (so-called) dry-earth or pail systems or improved privies can be approved, other than as palliatives for cesspit middens, because the excreta is liable to be a nuisance during the period of its retention and a cause of nuisance in its removal; and, moreover, when removed, leaves the crude sewage, unless otherwise dealt with by filtration through land, to pollute any watercourse or river into which such sewage may flow. We have no desire, however, to condemn the dry-earth or pail systems for detached houses, or for public institutions in the country, or for villages, provided the system adopted is carefully carried out. That the sewering of towns and the drainage of houses must be considered a prime necessity under all conditions and circumstances, so that the subsoil water may be lowered in wet districts, and may be preserved from pollution, and that waste water may be removed from houses without delay; and that the surface and the channels of streets, yards, and courts, may be preserved clean. That most of the rivers and streams are polluted by a discharge into them of crude sewage, which practice is highly objectionable. That, as far as we have been able to ascertain, none of the existing modes of treating town sewage by deposition and by chemicals in tanks appears to affect much change beyond the separation of the solids, and the clarification of the liquid. That the treatment of sewage in this manner, however, effects a considerable improvement, and when carried to its greatest perfection, may in some cases be accepted. That, so far as our examinations extend, none of the manufactured manures made by manipulating towns refuse, with or without chemicals, pay the contingent costs of such modes of treatment; neither has any mode of dealing separately with excreta so as to defray the cost of collection and preparation by a sale of the manure been brought under our notice. That town sewage can best and most cheaply be disposed of, and purified by the process of land irrigation for agricultural purposes, where local conditions are favourable to its application, but that the chemical value of sewage is greatly reduced to the farmer, by the fact that it must be disposed of day by day throughout the entire year, and that its volume is generally greatest when it is of the least service to the land. That land irrigation is not practicable in all cases, and therefore other modes of dealing with sewage must be allowed. That towns situate on the sea-coast or on tidal estuaries may be allowed to turn sewage into the sea or estuary below the line of low water, provided no nuisance is caused; and that such mode of getting rid of sewage may be allowed and justified on the score of economy.

The Richmond Vestry are making a great effort to substitute their own supply of water, for that hitherto given by the Southwark and Vauxhall Company, before the 13th inst. If we express a doubt of the possibility of their success, it is by no means with a view to discourage them in the attempt. We shall not endeavour to appraise the relative amount of blame attaching to the Water Company and the Vestry for bringing about the existing crisis. There have been faults on both sides, as usual; but if any serious interruption presently results, the blame must rest entirely with the Vestry.

Sale of Gas and Water Shares.—At a public auction on Friday last, five £10 shares (fully paid up) in the Sevenoaks Gas Company realized £100, and a similar lot £107. The last dividend was 7 per cent. Two £20 shares in the Sevenoaks Water-Works Company fetched £43, and one £10 share in the Tenterden Gas Company £14. On the 20th ult., at a sale by auction, three £10 shares in the Stoke Gas Company sold for £22 per share; 23 original paid-up shares of £10 each in the Longton Gas Company realized £20 per share; and five ordinary 7 per cent. shares fetched £14 5s. each.

Water Supply of Mexborough.—The local board of this town, at a meeting held on the 21st ult., passed the following resolution respecting the water supply:—"That this board allow the town to be supplied with water by a private company, in accordance with the regulations of the Local Government Board; this board reserving to itself the right to purchase the works at any time by paying to the company 10 per cent. profit on the original outlay." It was also resolved to throw the matter open to competition by advertisement.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

CXXIII.

Main-Pipes (*continued*).

In the case of clip joints, fig. 10, being employed, a taper or Λ-shaped bead is usually cast near each end of the several pipes, their distance from the ends varying from 1 inch to 2 inches, according to their size. The clips, in two halves, have recesses corresponding in

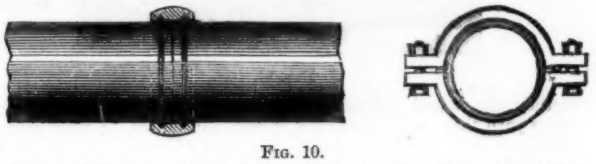


Fig. 10.

shape and distance apart to the projections on the pipes. The latter being placed in the trench, a belt of tarred webbing, of the proper width, and painted on both sides with a mixture of red and white lead, is put round the ends, the semicircular clips placed in position, and tightened by means of screw-bolts at their extremities.

This method of jointing is not much employed, and having had considerable experience with it, we cannot recommend its indiscriminate use. The slightest subsidence in the ground causes it to yield. As a joint for pipes about the gas-works premises it is extremely useful, from the ease and rapidity with which the pipes can be taken asunder and replaced when required.

Collar joints for main-pipes have been adopted by some engineers. These are, with but slight modification, the ordinary thimble arrangement generally used in uniting a broken main where spigot and socket joints are employed. That known as Belgrand's, fig. 11, made by Fortin Hermann Brothers, may be taken as a sample of this class

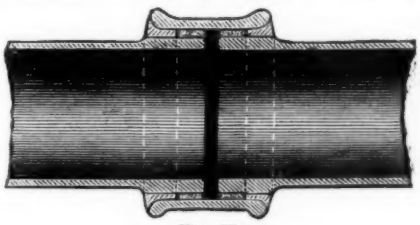


Fig. 11.

of joint. It consists in enclosing two cylindrical tubes, when placed together, with a cast-iron band, tarred yarn being driven in on both sides, filling up the space between the pipes and the band to within an inch and a half or two inches of the rim of the latter. Molten lead is then run into the collar at both ends, which fills up the remaining space, and this is beaten carefully in all round.

M. Chameroy's collar joint, for uniting his sheet iron and asphalt-coated pipes, already described, is shown in fig. 12. This is also

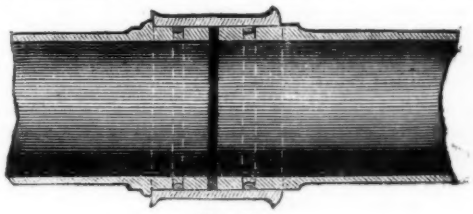


Fig. 12.

suitable for use in uniting cast-iron mains. A rounded projection or shoulder is cast on the pipe, about 4 inches from the end, with an annular groove to receive the hemp, caoutchouc, or other packing. The collar is of sheet iron, and is lined with lead, being made to fit closely on the pipes. When the packing has been placed in the groove on one end, the collar is driven over it, and hammered against the shoulder, and the end of the next pipe, also having its ring of packing material upon it, is inserted in a similar manner. A mixture of melted tallow and black lead is painted over the pipe ends, to allow of their sliding freely within the collar.

The conspicuous drawback attending the adoption of the collar is, that two joints have to be made in every connexion. Now, if the advantage of yielding under variations of temperature, without the risk of leakage, can be secured by the use of any other description of joint—as, for instance, that of spigot and socket, it is clear that the latter, on the ground of convenience alone, not to mention expense, is the preferable joint to employ.

The screwed joint of the same maker is shown in fig. 13. This,

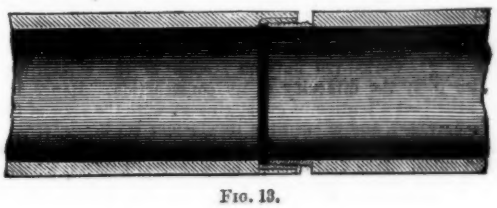


Fig. 13.

however, has been abandoned on account of its rigidity, and the difficulty of its manipulation with the larger sizes of pipes, in favour either of the collar-joint last described, or of the grooved spigot and socket joint, fig. 14. In uniting the pipes after this

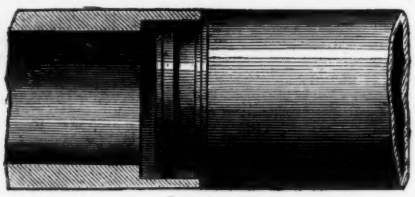


Fig. 14.

method, the spigot end containing the groove is bound round with hemp yarn that has been steeped in wax and tallow, or, what serves equally as well, in red-lead paint. A coating of black lead and tallow is then given to the two ends, and the joint completed by forcing the spigot of one pipe into the socket of the other. This joint, which is largely in use in France, is said to be cheap and durable, can be made with great ease, and affords perfect compensation in case of contraction and expansion from changes in temperature.

A form of screwed joint, applicable to cast-iron pipes, was patented by Mr. C. M. Barker, of London, and is shown in fig. 15. This construction of joint was not intended to be applied to pipes of greater diameter than 12 inches. The screws are cast with a lash or play on the thread, permitting the pipes to lie obliquely, or in a curve. In laying pipes of this description, the cones and cavities of the screws are filled with a luting of Portland cement, so that when the connexion is made, the luting is confined and compressed in the annular rings in such a way as perfectly to seal the joint and prevent leakage. Provision is also made for readily attaching junction-pipes by "cast lengthening screw sockets," with back nuts, as shown. Hexagonal bands, at regular distances, are also cast on the several lengths, to give a proper thickness of metal in drilling for the service-pipes.

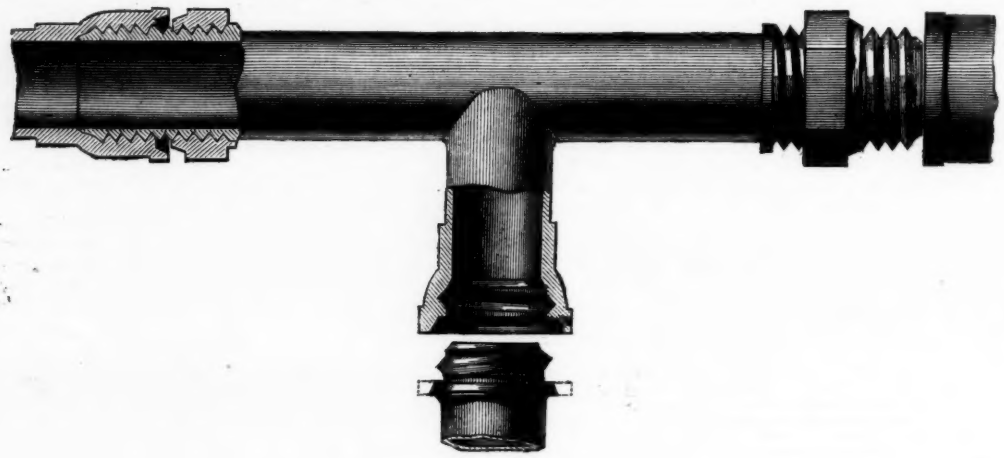


Fig. 15.

Communicated Articles.

FRENCH PRACTICE IN THE CONSTRUCTION OF GASHOLDERS.

At the Vienna Exhibition of 1873, the *Compagnie Parisienne d'Eclairage et de Chauffage par le Gaz* contributed various articles connected with their establishments, such as chemical products, drawings, models, and specimens of gas apparatus; and they published, at the same time, a "Note," in the form of a book of considerable size, intended to describe and explain the articles exhibited. This book contained much interesting matter, one chapter (with several plates) giving a description of the system of wrought-iron bitumenized mains, which have been exclusively used by the company for the last twenty years.

But the great bulk of the publication was devoted to a series of "Notes on the Construction of Gasholders," by M. Arson, one of the engineers to the company. These were afterwards presented separately, as a *mémoire*, to the *Société des Ingénieurs Civils* of Paris, and were published in their Transactions.

The engineers of the company appear to have devoted much attention to the various points which enter into the design and construction of these important portions of a gas establishment, and they have, with praiseworthy frankness and liberality, given their brethren in the profession the benefit of their experience and study.

The original *mémoire* may, I believe, be purchased,* or it may be referred to at the Institution of Civil Engineers in Westminster; but, as an account of its contents may be interesting to the readers of the Journal of Gas Lighting as an illustration of French practice and French ideas on the subject, I venture to offer the following notes.

To a large extent, they consist of a translation of the original; but I have not adhered strictly to this condition. I have in many places abbreviated the matter, or altered the forms of expression; always, however, preserving the sense intended. And I have further omitted some portions entirely, for reasons stated in each place.

Westminster, December, 1876. William Pole.

The gasholder is always a work of great importance in the design of gas-works, not only on account of the capital it absorbs, but also from the difficulty of its construction. Hence it should receive the best attention of gas engineers, with the view of diminishing its first cost, and of ensuring its efficient working.

The dimensions and proportions of a gasholder cannot be subject to fixed rules. It is desirable to have several holders, whose aggregate capacity (which will depend on the nature of the service to be performed) shall be capable of storing the gas made during the hours of minimum consumption.

It often happens that the diameter is determined by the area of land available, the height being then capable of variation. In good ground the depth of the tank may be carried to 12½ mètres (41 feet), and there is then little inducement to adopt the telescopic system. On the other hand, in ground where water is met with at a small depth, and where it would be difficult and costly to carry down masonry,* the telescopic system becomes applicable.

Whatever system be adopted, the design must inevitably comprise several parts of very different character, each of which will require the engineer's careful attention. The nature of the ground on which the structure is to be placed; that of the earth to be used for the filling in behind the masonry; the nature of the masonry, and of its coating; the bell† and its system of guides; the inlet and outlet pipes—these are all subjects which admit of considerable variation of treatment, and in respect to which it is necessary to judge with great discernment, in order to arrive at the most satisfactory and the most economical solution of the general problem.

A long and extended experience has thrown much light on the study of this problem, but it has not previously been treated in so precise and sure a method as has been lately done by the Parisian Company. The thickness of the masonry of the tank has been gradually reduced, but it has been uncertain to what limit this economy might be carried with safety; the chains and counter-weights, which originally ensured stability to the bell during its motion, have been abandoned, but the conditions of resistance to which the guides are subjected in consequence have not been fully appreciated. It is customary to use hydraulic seal troughs, to unite together the two rings of a telescopic bell, but there is no written law of any authority to guide the constructor in the determination of the dimensions of this junction.

The Parisian Company have not been satisfied with this kind of uncertainty. They desire that all their works should be designed on data so sure as to exclude the chance results of unreasoning experience; and for this reason they have studied and solved the various questions arising in the design of gasholders. In this study they have not advanced precipitately. In regard to each element, they have drawn out general rules, and have verified them in important practical examples, before publishing them as worthy of confidence.

It has not been practicable to provide for all possible cases that

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* Paris: Imprimerie Viéville et Capiomont, Rue des Poitevins, No. 6.

* The French word "*maçonnerie*" includes brickwork as well as stone. It is often customary to use the English equivalent in this more comprehensive sense, and I have done so here throughout.—Trans.

† "*Cloche*," a useful word to distinguish the inverted floating vessel, the term "gasholder" being applied to the structure generally as a whole. —Trans.

may occur; but it will be quite possible to draw, from the data given, rules that will furnish good solutions for other cases.

It will be convenient to consider the following subjects under separate headings, viz.:—

1. Earthwork.
2. Masonry.
3. Cements and coating.
4. The bell, simple or telescopic, with its guide-rollers.
5. Inlet and outlet pipes.
6. Guides.
7. Scaffolding for the construction and support of the bell.

I.

Earthwork.

The construction of a large gasholder begins by the excavation destined to receive the masonry tank.

Examination of the Nature of the Ground.

The ground in which the excavation is dug may be of three different kinds—

Firm, and capable of being left with steep sides; or

Loose, and requiring slopes more inclined; or

Firm in some parts, and loose in others, as usually happens where the solid natural ground has been partially covered with loose earth.

The first case is the most advantageous that can happen, and need not be further commented on.

The two others may be considered as identical as regards the execution. It is expedient always to remove the loose earth, and substitute for it something that offers sufficient resistance. We may form spurs of masonry to act as buttresses supporting the tank wall, or simply increase the thickness of the latter till sufficient resistance is obtained; or we may interpose between the exterior of the wall and the natural ground, a filling in of earth (*remblai*) of sufficient resistance to arrive at the same result. This latter plan is evidently the cheapest, and it has been employed in many cases with success, especially in the construction of a gasholder of 25,000 cubic mètres (880,000 cubic feet) erected at the gas-works at Les Ternes.* It is expedient to give some particulars of this, one of the largest erected in Paris.

The loose earth removed had to be replaced by filling of proper resistance. The tank required to be 1·30 m. (4 feet 3 inches) thick, and it had to support at its base a column of water of 12·75 m. (42 feet) tending to thrust it outwards.

The artificial earth, which had to be removed beyond the theoretical excavation, amounted to 6800 cubic mètres (9000 cubic yards), presenting a maximum width of 12 mètres (40 feet). It was replaced by sand watered and rammed in thin layers, brought up *pari passu* with the masonry of the tank.

It is well known that sand watered and rammed constitutes an excellent foundation for buildings where vertical pressures have to be resisted. The resistance to horizontal pressures has been determined by direct experiments which are about to be described.

Experiments on the Resistance to Compression offered by Earth-Filling.

[These are described in the original at considerable length, and drawings and dimensions are given of the apparatus employed. I have not thought it necessary to reproduce all this in the present paper; it will suffice to give a general brief description, stating the results obtained. The details can be easily referred to in the original.—Trans.]

The experiments were made on three kinds of material—namely, sand, white tufa of the Parisian beds (a light stony powder), and vegetable earth mixed with gravel, which is common in the neighbourhood.

A portion of the material to be tried was filled into a frame, being watered and punned, in thin layers, as it would be in actual use. It was then pressed horizontally with a piston of known size (for low pressures, one mètre square; for high pressures, one décimètre square) and the pressure was noted when the piston first began to move—*i. e.*, when the resistance of the material was attained. Each material when rammed weighed about the same—namely, 1800 kilogrammes per mètre cube (112 lbs. per cubic foot).

The resistances found were—

	Kil. per Square Dècimètre.		Pounds per Square Foot.
Sand	100	..	2050
White tufa	80	..	1640
Vegetable earth with gravel	44	..	900

The punned sand transmits the pressure very badly, the molecules butting one against the other, and hence it forms an excellent filling, as well as an excellent foundation.

As a result of these experiments, the engineers of the Parisian Company, charged with the construction of the gasholder at Les Ternes, have not hesitated to supply, by a filling of watered and punned sand, the earth removed between the exterior of the masonry tank and the natural ground in which the excavation was made. The upper part, about 1½ mètre deep, having to sustain but little pressure, was, for economy, rammed with ordinary earth.

II.

Masonry Tanks.

The masonry which composes the tank of a gasholder absorbs a large portion of the total cost, and requires, therefore, scrupulous consideration.

In the preceding section, the conditions of external resistance have been laid down. When the depth of the tank exceeds 10 mètres (32·8 feet), it is indispensable to make the masonry co-operate in the strength.

The masonry of the tank possesses two elements of resistance—its *weight*, which opposes the overturning of each elementary vertical prism, into which the whole may be supposed to be divided; and its *cohesion*, which offers a horizontal resistance that must not be neglected. These elements vary, moreover, in their value, according to the nature of the materials employed.

The tank may be built either of brickwork or of rubble stone masonry. The mortar is prepared with hydraulic lime, more or less quick-setting, or with Portland cement.

Choice of Material.

Bricks, if sound and well burnt, make an excellent material for the construction of a gasholder-tank. Their price, and their abundance on the site, will determine their choice. They are not obtainable in Paris, and consequently the Parisian Company have been obliged to have recourse to stone.

For rubble stone, each stone should have two parallel faces sensibly plane, rendering its setting easy and secure. Its hardness is a secondary matter, but it ought to be greater than that of the mortar used. It ought not to be friable, as this character corresponds to a bad quality, which may cause it to disintegrate under frost or other actions.

Placing of the Material.

Whatever be the materials chosen, they ought to be so laid as to satisfy one condition, which can alone ensure the co-operation of the resistance of the ground.

If the ground is cut and shaped to correspond with the exterior form of the masonry, the latter ought to be made to bear forcibly against it. Each stone should be struck horizontally, so as to impress itself against the earth, and squeeze out the mortar placed between them, by which means the pressure of the water in the tank may be transmitted by the masonry to the earth without displacement or fissure of any part of the work. This condition is indispensable to ensure the resistance of the earth.

If partial slips occur in the ground, the cavities must be carefully filled, either with masonry or rammed sand, in order that the pressure may be transmitted to the solid earth behind.

Mortar.

The mortar used plays an important part in the success of the work. Limes which are feebly hydraulic, or even those which become very hard under water, but which set slowly, are inconvenient in use. Those which set too quickly, like Roman cement, are difficult to use, and almost always make defective work. Portland cement, which takes twelve hours to set, is the material best suited to ensure a good construction.

Thickness of the Tank Wall.

The thickness and the form of the tank wall depend both on the requirements of the work it has to support, and on the resistance it has to add to that of the ground. If the ground is solid. and if it can be excavated with vertical sides, the tank wall should have a uniform thickness. If the ground is loose, having first to be excavated with a slope and then filled in again, as is the case with sand, the wall may be brought up with a reduced thickness, except under the seats of the columns where piers will be formed. This latter mode has been adopted at Vaugirard with complete success.

Determination of the Forces and Resistances in a Gasholder-Tank of Masonry.

The study of the equilibrium between the thrust of the water in a gasholder-tank, and the resistances offered by the masonry and its earth backing, constitute a problem easy to solve with the aid of the data which the Parisian Company have obtained.

In the first place, observation has shown that the rupture of these tanks has always occurred in a vertical fissure, widest at the top and diminishing as it descends. We are therefore justified in considering that the work is exposed to an effect of tilting or overturning, having its greatest movement at the summit, and not, as might have been supposed, to a rupture at the base, where the pressure is greatest.

It has also been observed that the overturning movement actually produced is extremely limited, that it often appears only as a crack scarcely discernible; and we are led to conclude that this small displacement suffices to bring into play the resistance of the earth to such an extent as to limit the disturbance. Hence we may further infer that a previous pressure of the earth against the masonry would have prevented the rupture, and we see the importance of causing the masonry to abut strongly against its earth backing, as previously directed.

Starting from these considerations, the analytical study of the question will show that the tendency is to break the cylindrical tank into two equal parts, by a vertical line of fracture passing through the axis of the cylinder, each half tending to move outwards in opposite directions. It is also necessary to assume that the resistances of the masonry and earth are uniform in all parts of the circumferance, and to neglect any change of form.

The forces to be considered are—on the one hand, the pressure of water; on the other hand, the weight of the masonry, its cohesion, and the pressure of the earth backing.

(To be continued.)

* The most important gasholder of the company is that constructed at La Villette in 1870-1, having a capacity of 31,000 cubic mètres (1,100,000 cubic feet).

Gas Explosion at Sheffield.—On Thursday night last a somewhat alarming explosion of gas, which had escaped from a leaking joint, took place in the St. Paul's School-room, Sheffield, doing some damage, and seriously injuring a man living on the premises.

CONTRIBUTIONS TO THE THEORY OF LUMINOUS FLAMES.

By Dr. KARL HEUMANN.

[Translated from the *Journal für Gasbeleuchtung*]

PART FIRST.

Until lately, Davy's theory of luminous flames sufficed to explain all observed phenomena; but a series of researches has since then enlarged our knowledge of the subject by many facts which cannot be made to harmonize with the theory hitherto accepted.

Thus the luminosity of the flame of hydrogen and of carbonic oxide, under high pressure, observed by Frankland, contradicted the idea heretofore entertained, that the brilliancy of a flame was derived from solid particles floating in it, and raised to a white heat; and the observation of Knapp, that the flame of illuminating gas lost its brilliancy, not only by an admixture of air, but also by admixture of a certain proportion of nitrogen, or of carbonic acid, with the gas to be burned, could no longer be explained by an immediate oxidation of the carbon contained in the flame.

From these, and similar considerations, it appears that Davy's theory no longer suffices, and that it must be modified, or altogether replaced by a new one. But it also appears to me certain, that the latter alternative is unnecessary, and that a complete reversal of the hitherto received views is not required. The present paper will, therefore, be directed more to the enlargement of the existing theory than to its supersession. The genius of Davy is specially manifested in the circumstance, that his hypotheses are neither overthrown nor even greatly shaken by new discoveries which he could not possibly have anticipated, but that they only require to be remodelled on a broader basis to suffice for the present state of science, so much richer in ascertained facts.

I cannot refrain from quoting H. Kopp's* remarks with reference to Davy's theory of combustion: "From the history of chemistry we learn better to appreciate the real value of scientific researches, and we arrive at the conviction, that every labour, and the elaboration of every theory, however complete at the time of its promulgation, is only a preparatory step to subsequent increased knowledge, so that no views can claim to be retained without modification, and the best result is that which, while fulfilling the requirements of the day, itself induces increased research in such a direction that it may more speedily be replaced by a better one; that the best contribution to science is one which contains within itself the germ of some fresh discovery, which shall ultimately supersede it."

As a rule, I have retained the chronological order in which the several researches have been made, for only in this way is it possible to carry out logically my chain of argument. A more systematic arrangement would, no doubt, be to give the simpler first, and then the more complex; but, in the case before us, the complicated subject of the carbon-containing luminous flames has, on account of its great importance, been the most studied, while the experience here gained, and views formed, will find their application to, and confirmation by, simpler flames, and thus elucidated and corrected will serve to explain all flames.

Carburetted Hydrogen [*Hydrocarbon*, German, Kohlenwasserstoff] *Flames; their Disillumination*† *and Reillumination.*

Most researches hitherto on the luminosity of flames have dealt exclusively with those whose illuminating power was attributable to the presence of carbon, and many observers endeavoured to solve the problem of the origin of luminosity by appliances for diminishing or withdrawing light. In fact, this apparent *detour* offers many advantages, but its chief disadvantage has not been sufficiently allowed for; this disadvantage, which tends to vitiate the conclusions drawn, consists in the complication of relations by the simultaneous introduction of various agencies, of which some will act in similar, and others in opposite directions, in experiments on disillumination.

The neglect of this circumstance has led to experiments yielding directly contradictory conclusions, and thus, since Davy's theory is proved insufficient, we are still without any comprehensive point of view from which to explain the luminosity of flame.

Frankland suggested the hypothesis, that it was not solid, glowing carbon, suspended in a flame, which caused the luminosity, but rather dense, glowing vapours of hydrocarbons which emitted the white rays. It was, however, hardly possible to bring forward proof of this theory, which completely upset the usually received explanation, and Frankland, therefore, based his views chiefly on his observations, that many flames yield a bright light where there can be no possibility of solid glowing particles. To the well-known instances of the considerable luminosity accompanying the combustion of arsenium, phosphorus, and sulpho-carburets in oxygen, he added the interesting observation, that hydrogen and carbonic oxide will burn in oxygen, under a pressure of from 10 to 20 atmospheres, with a bright flame, yielding a continuous spectrum, and that even the feeble flame of spirits of wine will, under a pressure of 18 to 20 atmospheres, burn as brightly as a wax candle.‡

The former results are not so surprising as might at first sight be imagined, for increased pressure raises the temperature of the flame, as St. Claire Deville had announced,§ and it is well known that many gases, when their temperature is increased, will, under electric discharge, yield a continuous spectrum instead of single lines.

The light-emitting power of gases then varies greatly under these conditions, and it does not seem a necessary conclusion, as Frankland assumes, that the increased luminosity is due to the greater density of the gas, though this may probably contribute to the result.

But the explanation of these appearances is quite independent of the question as to the nature of carbon-containing luminous flames, and though Frankland adduces the above-named phenomena of combustion as analogous to his views respecting carbon flames, they do not really afford any proof; for, as W. Stein* pertinently remarks, it is not proved that the process in carbon flames is necessarily analogous.

Frankland's assertion that soot is a collection of the densest light-giving hydrocarbons, the vapour of which is condensed on the cold body introduced into the flame, may be considered as refuted by W. Stein's argument, that in this case the soot ought, at a high temperature, to be reconverted into vapour (which is not the case), and so this portion of the accepted theory of flame, in so far as it refers to flames containing carbon, remains unimpaired.†

Fresh doubts as to the accuracy of the prevailing views were entertained when Knapp announced‡ that not only atmospheric air, when mixed with coal gas, rendered the flame non-luminous, but that nitrogen, carbonic acid, and other perfectly neutral gases produced, the same effect. It was no longer possible to ascribe the cessation of brilliancy to the immediate oxidation by the air of the carbon separated in the flame, because gases perfectly free from oxygen produced the same effect; and Stein,§ as well as R. Blochmann,‖ in attempting to explain this result, while maintaining the instantaneous conversion of the carbon of the flame into carbonic oxide, was forced to assume that the oxygen of the atmospheric air was enabled to penetrate the flame more freely, and so oxidize the carbon particles more readily.

While the two last-named authors regarded disillumination as occasioned solely by rarefaction, F. Wibel,¶ on the other hand, propounded an entirely different theory, according to which absorption of heat from the admission of the neutral gas is the only cause of the disillumination.

Wibel arrives at this conclusion from observing that a mixture of coal gas and air, nitrogen, or carbonic acid gas, burning with a blue flame, becomes a bright flame yielding soot, if the burner from which it issues is made red hot. In this case the rarefaction of the flame-gas would be increased by the higher temparature, and yet the flame becomes luminous.

To judge of the admissibility of the sweeping deductions from this observation, it is necessary to consider more closely the manner in which Wibel conducted his experiments. He says: "On an ordinary Bunsen burner, the air-openings of which are all closed, except one, through which the disilluminating gas is introduced by means of a tube luted on, is placed a platinum tube, 8 to 10 centimètres long, and which is easily made by rolling spirally a strip of platinum. The ordinary luminous gas flame is produced of a moderate length, and the neutral gas introduced till complete disillumination is attained; the platinum tube is then heated from the outside by two non-luminous horizontal Bunsen flames, diametrically placed, so as to heat the tube equally all round. . . . Even with the ordinary Bunsen flame—that is to say, disillumination by air—the same result is obtained by placing the platinum tube over the mouth of the burner, and heating it."

This latter result, as described by Wibel, especially requires very careful examination before we can be justified in identifying the disillumination in the Bunsen burner with Knapp's experiment.

Some time ago Barentin** made the observation that the volumes of light-giving (coal) gas escaping in equal times from a burner vary greatly according as the gas is lighted or not. Barentin considered the 26·33 per cent., &c., less volume escaping when the gas is lighted, to be accounted for by the counter-pressure exerted by the burning, and therefore expanded, gas, on that pressing in its rear; Blochmann,†† however, showed that the diminished consumption of gas was entirely owing to the increase in volume sustained by the gas in passing through the heated top of the burner.

It is possible, therefore, that the illumination of a gas mixture issuing from a Bunsen burner through a heated tube may arise from other causes than that assigned by Wibel—namely, the higher flame temperature; for it is *primâ facie* improbable that the volume of gas, and also the volume of air absorbed, should be quite unaffected by the passage through a long glowing hot tube, and just as little can it *à priori* be affirmed that exactly the same relation obtains between the air and the coal gas in passing through a cold as through a heated tube.

I was, therefore, induced to vary the conditions of the experiment, so as to eliminate this possible effect of the heated tube on the result.

By heating, not the mixture, but say only the neutral gas, the result must remain exactly the same, if the increased temperature of the flame is the cause of the brilliancy, and, in fact, the experi-

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* H. Kopp, "History of Chemistry," i., 16.

† For the sake of brevity, and in accordance with precedent set by others, I shall use the words disillumination to signify the disappearance of the yellowish-white light, yielding a continuous spectrum, usually emitted by flames containing carbon; the flame then appears blue, and the light exceedingly feeble. A complete cessation of all light would, of course, be equivalent to extinction of the flame.

‡ *Dingler's Journal*, 1875, pp. 341, 369. Compare also L. Cailletet, *Comptes Rendus*, lxxx., 487.

§ *Comptes Rendus*, lxvii., 1089.

* *Dingler's Journal*, 1875, pp. 317, 543. Compare *Journal of Practical Chemistry* (2), viii., 401, *et seq.*

† In a subsequent chapter I shall refer again more specially to the nature of the light-yielding body.

‡ *Journal of Practical Chemistry* (2), i., 425.

§ *Journal of Practical Chemistry* (2), ix., 180.

‖ *Dingler's Journal*, 1873, pp. 395 *et seq.*

¶ *Dingler's Journal*, 1875, p. 287. "Reports of the German Chemical Society," viii., 226.

** *Pogg. Annal.*, 107, 183.

†† *Schilling's Journal für Gasbeleuchtung*, vol. v., p. 355.

ment may easily be made with the Bunsen burner, by inserting tubes of rolled platinum foil about 7 centimètres long into the two lower air-holes, the outer openings of these tubes being compressed till only just sufficient air for complete disillumination is admitted. Instead of the ordinary brass burner, a thin glass tube must be used, such as a test tube, with the bottom removed, as the metal tube would cool the heated air too rapidly. If the coal gas mixed with cold air be lighted at the top of the glass burner, the latter being protected by a ring of platinum to prevent any colouring of the blue flame through the ingredients of the glass, and the two platinum tubes are then heated by powerful Bunsen heat-flames (preventing, however, any of the products of their combustion from entering the platinum tubes), the blue flame on the glass burner will become bright as soon as the platinum tubes are glowing hot.

This result might, however, be explained by the gas, in fact, requiring just as great a volume of air with heated as with cold platinum tubes; but that the actual volume of air admitted is in the first case much less, and that the oxygen contained is, therefore, not sufficient to destroy illumination by complete combustion of the carbon. To remove this objection, and to prove that the brightening of the disilluminated flame was due entirely to the heat imparted, the experiment had again to be varied.

The coal gas was now collected in a gasometer, and air or carbonic acid gas carefully introduced, till the mixture, on issuing from a platinum tube about 10 c. long and 8 mm. in diameter, burned with a perfectly blue flame. The platinum tube being now heated, the brightness of the flame rapidly increased, and at length became nearly as brilliant as if pure gas was burning. When the heating apparatus was removed and the platinum tube cooled, the flame of the mixed gas became proportionately feebler, and finally became again perfectly blue.

Only now are we justified in concluding that *the increased heat alone* had made the flame bright, for diminished access of air could not, as in the former experiments, have had any influence on the result.

It was necessary further to ascertain, whether the gas mixture which in consequence of being heated burned with a brilliant flame, might not have been altered in such a way that it would now burn with a brilliant light even though cooled again to its original temperature. In other words, if the brilliancy be caused directly by the higher temperature, and not by any chemical change taking place, the gas mixture, which burns with a bright flame when issuing from a heated burner, ought again to yield a blue flame if it can be cooled after passing through the heated tube, and then lighted.

This experiment was conducted by passing glass tubes on to each end of the platinum tube and fastening them with putty; the mixture from the gasometer was then admitted through one glass tube into the platinum tube, and passed into the second glass tube, which was bent into a U form and surrounded with cold water. When the gas escaping from this tube was lighted, it burned with a perfectly blue flame, which did not become brilliant however strongly the platinum tube was heated. But when the refrigerating glass tube was taken away, and the gas lighted at the end of the heated platinum tube, it yielded a bright flame.

A still more simple method is to allow the blue flame, yielding mixture, say of coal gas and carbonic acid, to escape from a platinum tube, 12 to 15 c. long, and then light it. If the platinum tube be heated near the open end, the blue flame immediately becomes brilliant; but if the tube is heated further from the flame, the latter does not become brilliant, because the heated gas is cooled again by passing through the cold portion of the platinum tube.

In employing air and coal gas, Wibel noticed that under certain conditions "the gas escaping from the burner will show by its proportion of water and carbonic acid, as well as by brilliancy under ordinary combustion (I suppose he means after having been previously cooled), that a partial decomposition has taken place." But this will depend especially upon the proportion of air and coal gas, and on whether the heating process may not have been carried too far.

While Wibel observed, in the passing of air and coal gas through a glowing platinum tube, a not inconsiderable deposit of carbon, my own experiment, in which only the air drawn in by the Bunsen burner passed through the heated tube, showed neither soot nor tar deposit in the glass burner, even after lengthened combustion. That such a deposit took place in Wibel's experiment is probably due to some local overheating of the particles of the gas mixture in immediate contact with the platinum. Therefore such a very high temperature is not necessary for obtaining the results sought for.

Wibel draws a sweeping conclusion from the reillumination by heat of a flame disilluminated by a neutral gas. He rejects the explanations of previous observers, but falls into an opposite extreme. He ventures, *e.g.*, on the following conclusions:—

1. The disillumination of a flame, in Knapp's experiment, cannot be caused by rarefaction of the gas, as understood by Frankland, or by Blochmann, for in the above experiments any rarefaction could only be increased by heating, and yet brilliancy was produced.

2. The disillumination in Knapp's experiment, as in the simple Bunsen burner, depends on the cooling of the interior of the flame by the gases entering. If the latter are heated, the gas becomes brilliant.

Wibel finds "a most remarkable confirmation" of these two assertions in the peculiar action of flame produced by coal gas and oxygen. On the one hand, disillumination was most difficult to effect, even with a strong current of oxygen, and the application of a wire-gauze screen for cooling; and yet, on the other hand, under proper arrangements, it afforded an intense light. Both these circumstances, in Wibel's opinion, go to show that neither rarefaction nor oxidation bear any active part in disillumination.

Put in this form, Wibel's theory is at once proved incorrect, if applied to the disillumination by air of the flame in a Bunsen burner, because daily experience shows that the flame of the Bunsen burner, as well as every blow-pipe flame, possesses a much higher temperature than the more brilliant flame; while, according to Wibel's explanation, the disillumination, being caused by a cooling of the bright flame, the logical result would be a lower temperature in the blue than in the bright flame.

Even if one were disposed to consider a flame disilluminated by air as belonging to a different category from flame disilluminated by a neutral gas, and, therefore, to allow it an exceptional position, this would not mend matters, for the Bunsen flame, in respect to becoming brilliant, behaves precisely like the flame in Knapp's experiment, the only distinction—viz., the higher temperature due to the oxygen of the air, not being relatively altered by the heating of the burner, yet brilliancy ensues. But while, in the case of flame, disilluminated by a neutral gas, it might be assumed that the heat absorbed from the heated tube only served to replace the heat absorbed by the inert gas introduced, the otherwise analogous case of disilluminating by air contradicts this explanation, because there can be no question of withdrawal of heat from the luminous matter when the flame itself becomes much hotter.

In disilluminating experiments with perfectly neutral gases free from oxygen, the temperature of the flame is naturally much reduced, because the heat is spread over a larger quantity of gas.

But W. Stein* has shown that, in these cases also, some other cause than a diminished temperature of the coal gas is operative; he shows that a gas, disilluminated by nitrogen still possessed a temperature sufficiently high to decompose coal gas passed through the flame in a glass tube, and produce a deposit of carbon; he observed further, that a gas, itself combustible—namely, carbonic oxide, the pyrometric effect of which closely approximates to that of coal gas, will disilluminate the flame of the latter. One volume of coal gas required for complete disillumination in the Bunsen burner 1·6 volume, and in the Brönner burner 0·9 volume of carbonic oxide. In this case, therefore, disillumination takes place without any material diminution of heat, and the only alternative left is the belief that rarefaction of the burning gas is, in reality, an important element, and by itself alone, apart from the often co-existing diminution of heat, is capable of disilluminating flame.

Wibel's experiment, therefore, by no means proves, as its author supposes, that the cooling of the interior of the flame is the whole and sole cause of disillumination, because the flame is at the same time, by the admission of the neutral gas, very materially altered in its composition—*i.e.*, much rarefied.

When, therefore, some observers consider disillumination by an admixture of gas as due *solely to rarefaction*, while Wibel ascribes the effect *entirely to refrigeration*, it would now appear that the truth lies between these two opposite views.

It is difficult to devise experiments in disillumination, in which several causes may not be combining to produce the effect, and yet everything depends on severing, as far as possible, causes of disillumination not hitherto sufficiently discriminated. Only in this way does it become possible to obtain a clear idea of what is going on within the flame by studying separately from all others the operation of each individual cause that comes into play, and so dividing the very complicated relations into simple but simultaneous processes.

To this end it seemed necessary to bring the old maxim, that a flame is disilluminated by refrigeration, to a crucial test, by an experiment which should exclude all possibility of any other explanation. I proceded in the following way to prove that refrigeration alone can disilluminate a flame, and that simply restoring heat will restore brilliancy, neither rarefaction nor oxidation interfering to affect the result.

From the point of a luting tube, or similar narrow tube, a gas flame, 3 to 4 centimetrès in length, is produced, and directed horizontally against a vertically hung platinum plate, in such proximity that the flame spreads out and becomes perfectly blue.† We are not, however, justified in ascribing this well-known case of disillumination simply to refrigeration by the metal plate, because the flame has spread out, and its constituent particles offer a much more favourable surface to the air for oxidation, rarefaction, and refrigeration.

If the platinum surface is now heated to glowing, from the opposite side, by a powerful Bunsen burner, held horizontally, the gas flame becomes more brilliant as the temperature of the platinum surface rises, and finally regains its former brilliancy. Of course the metal plate must be perfectly clean, and must not be touched by the finger during the experiment, or the light will show a colour.

This proves that increase of temperature alone caused the brilliancy of the flame to return when disilluminated by the platinum plate.

If the Bunsen burner is removed, the gas flame remains brilliant for a short time, and then gradually becomes blue as the plate cools.

In this last experiment of disillumination by refrigeration, the objection could no longer be entertained, that the extension of the flame had any influence, because the slight change in volume produced by the cooling would tend in the opposite direction.

It is therefore experimentally proved that *refrigeration alone act as a disilluminator on flame.*

I have already noticed the reasons which justify us in concluding that rarefaction of a flame, by mixture of other gas, will also of itself

* *Dingler's Journal*, 1874, p. 543. *Journal of Practical Chemistry*, ix. 183.

† There is no deposit of soot from a blue flame.

produce disillumination* (Bunsen's flame, disillumination by carbonic oxide), and as a cold gas introduced into the flame will act as a heat-absorber equally with a metallic plate, we come to the conclusion that *the disillumination of carbon-containing flames by the introduction of a neutral gas, is caused not only by refrigeration (absorption of heat), but also by rarefaction of the flame gas.*

The fact that a flame, disilluminated by neutral gas or air, again becomes brilliant by heating the burner, I think may be explained by the following position:—A blue burning mixture of gas, consisting of coal gas and neutral gas or air, requires a higher flame temperature to make it brilliant than the temperature belonging to the brilliant unrarefied flame. In the disillumination by air in the Bunsen burner, the flame, in consequence of the concentrated combustion, becomes far hotter, and yet only becomes brilliant when, by heating the burner, the flame temperature is raised still higher.

The support which Wibel found for his theory in the action of coal gas and oxygen gas, is explained by my view very exactly. When oxygen is introduced into one of the lower openings of a Bunsen burner while the other opening is closed, Blochmann observed, and Wibel confirms him, that disillumination becomes exceedingly difficult, and can only be effected by a strong current of oxygen and a cooling wire gauze; simply because the flame temperature, when pure oxygen is present, is very high.

The absorption of heat by the admission of the cold oxygen, as well as the absolutely higher temperature required by the mixture to become brilliant, are supplied, or nearly so, by the intense heat caused by the active, concentrated combustion in presence of pure oxygen. This causes disillumination to be so difficult; of course, a strong current of oxygen and cooling gauze will, at length, effect it.

It is well known that the introduction of pure oxygen in a proper quantity and manner will cause a gas flame to become exceedingly brilliant, a fact which, no doubt, is also based on the production of the highest possible flame temperature without, as when air is employed (in the Bunsen burner or blowpipe), the existence of a rarefaction highly detrimental to the brilliancy by the neutral nitrogen.

In this experiment it appeared that the greatest brilliancy of the flame occurred when the oxygen was introduced in a very moderate stream, but that a larger admixture of oxygen, equally with too small a one, produced a much feebler intensity of light. As, apparently, a much higher flame temperature ought to be attained when the quantity of oxygen corresponding to the maximum brilliancy was increased, it induced the conjecture, that the disilluminating effect of the excess of oxygen was not only through rarefaction and refrigeration, as with neutral gases, but that a third, perhaps still more powerful, cause must be in operation, and that this was to be fonnd in the rapid oxidation of the light-producing matter.

This induced a more careful examination of the changes caused in the coal gas flame by an excess of oxygen.

If a flame from a wide burner is introduced into an atmosphere of pure oxygen, a greatly increased development of light takes place within the luminous flame-cone, which is much reduced in size, while the outer, non-luminous envelope is enlarged.

To show more clearly the effect of pure oxygen on the combustion of the light gas, it readily occurred to me to make the flame very thin, by letting the gas issue from a very narrow tube, or a slit-burner. The result was very surprising.

If a gas flame 4 to 5 centimètres long, issuing from a luted tube, is conducted into a vessel filled with oxygen, and with the mouth turned downwards, the flame is at once altered in shape; the outer, scarcely visible, envelope extends enormously towards the interior, and occupies nearly the whole of the luminous portion of the flame. Only a very small brilliant point represents the originally considerable light-cone, while the whole flame has become considerably less than its size in atmospheric air. This is caused by the absence of rarefaction through nitrogen, which cause also necessarily produces a much higher flame temperature. This kind of disillumination can be referred to no other cause than the considerable excess of oxygen which is diffused in the narrow flame, and causes immediate oxidation of the carbon, so that this latter is not obliged to remain for a time glowing, while rising in the flame to find further outwards, sufficient oxygen for complete combustion.

If this explanation be correct, it follows that this kind of disillumination through oxygen gas can only take place in flames, the luminous portion of which is converted by excess of oxygen into a feeble light, but that flames whose light depends on the presence of a glowing fixed or vaprous body not oxidizable by oxygen into a feeble light, should, even when issuing from the *smallest* aperture, always burn with a brilliant light in an atmosphere of pure oxygen gas, while the light will be increased because the flame temperature is considerably raised.

Direct experiment confirms this conclusion, and therefore the premises, most completely.

Hydrogen gas saturated with chromoxychloride, $Cr\,O_2\,Cl_2\,[Cl\,]$, the flame of which is due to glowing chromoxide, burns in pure oxygen, even from the smallest aperture, with a brilliant white light. Hydrogen gas saturated with the vapour of fuming chloride of tin $Sn\,Cl_4\,[Cl_4]$ also yields, under these conditions, a blue flame, of much greater brightness than when burnt in atmospheric air. The product of combustion in this case also is a fixed, non-volatile substance (oxide of tin).

(To be concluded.)

* Frankland has also observed that rarefaction of a flame through diminished atmospheric pressure produces a diminished brilliance of carbon-containing flames, and has established the fact that the enfeeblement is in proportion to the diminished pressure. I have not, however, adduced his experiment as a proof of the disilluminating effect of rarefaction, because it is not an absolute demonstration; for the diminished pressure also occasions a reduction in the temperature of the flame by which also the light may be enfeebled.

Correspondence.

QUANTITY OF BRICKWORK IN RETORT-SETTINGS.

"Let me have facts—I want facts!"—*Bounderby.*

SIR,—I demur to the conclusion of your correspondent "C. T. S." (*vide* last week's JOURNAL), that the arguments in vol. xxiv., p. 227, demonstrate the error of the opinions of those who are in favour of putting a proper and reasonable quantity of brickwork in an oven of gas-retorts. The arguments referred to are irrelevant to the subject, as was well pointed out by a correspondent in the same volume, p. 538. No one that I am aware of desires to employ a useless excess of brickwork in a setting, the effect of which would be simply to obstruct the draught. There is, however, a happy medium that may be attained without following the *ipse dixit* of one that is fond of referring with tiresome iteration to the result of certain very questionable experiments with some unheard-of (either before or since) Belgian retorts. These, though supported only at the extremities, were asserted to be in such perfect preservation, after two or three years working, as to be intact from end to end, being fit for resetting, and were indeed reset. It would have been more satisfactory to have been told what the production of these none-such retorts was during the "two or three years," and what the consumption of fuel. Did any but the author of that racy anecdote ever hear of such wonderful prodigies? I fear they are as scarce as the fabled salamander or the sea serpent we read of every now and again. The name of the maker of these unique retorts, too, is withheld "for obvious reasons." In what respect "obvious"? Is it not obviously to the advantage of gas managers to know where to get the best article? It is simply unfair to whisper these big stories to the gas maker, giving "no name," and placing him in the position of the unfortunate Tantalus, who was made to stand up to his chin in water, with branches of fruit hung over his head, the water receding when he wished to drink, and the fruit when he desired to eat.

It is a fact to which there is abundant testimony, that English or Scotch clay retorts, set seven in a bed, and properly supported by transverse walls, produce from 5000 to 6000 cubic feet of gas per mouthpiece per diem during a period of three to five years, and with an expenditure of fuel under 20 per cent. Can Belgium, or Barcelona, or Brixton beat that?

The author of the Belgian story recently propounded the question, "What becomes of the light from a lighted candle when placed under a bushel?" George Stephenson answered that query by anticipation when he spoke of the sunlight bottled up in the coal. It would be more *à propos* of the subject, however, to ask, "What is the action of a sponge with water?" It absorbs its quantity, of course; but it does not go on absorbing it. No more does the brickwork go on absorbing the heat of the furnace. There, I have had my snarl; but the recital of that Belgian story, and the no-support theory, are enough to stir up the bile of a saint, much more that of your correspondent,

S. N. A. P.

THE "CHAMEROY" PIPE-JOINT.

SIR,—We have read with pleasure the particulars given by you in the article "A Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas," contained in your JOURNAL of the 28th of November last, respecting the pipes of our company. We desire, however, to point out to you an error which has crept into the sixth paragraph. You say, "On the other hand, engineers who have had experience in their use have condemned their employment, though principally on account of the difficulty of making the joint." Our system of jointing, called the "*joint précis*," is acknowledged by all engineers, even by those in England, to be the one which has attained the highest perfection, and which offers the greatest facility for laying pipes in trenches. You could call upon the directors of the European Gas Company, who are proprietors of the gas-works at Amiens, Caen, Boulogne, Havre, Nantes, and Rouen, and whose head offices are in London, and obtain a confirmation of what we are now writing.

If, in saying "making the joint," you mean "inserting a branch-pipe," there also you are in error.

In support of the rectification which we have now the honour of addressing to you, we enclose a list of the works executed by us from 1838 to Dec. 31, 1875, showing that we have delivered 9,200,000 mètres (about 5680 miles) of "Chameroy" pipes of from 1 to 0·035 mètre (39 inches to 1½ inch) internal diameter, representing more than 60,000,000 francs. The Paris Gas Company alone have laid more than 1,500,000 mètres (about 930 miles) up to the present time; while the European Gas Company, and many other very important undertakings, still make use of our pipes exclusively.

Paris, Dec. 28, 1876. CHAMEROY AND CO.

LIGHTING BY ELECTRICITY.—Professor W. A. Anthony, of the Physical Department, Cornell University, U.S.A., sends the subjoined account of a recent experiment to the *Scientific American*:—"The following is a brief description of my experiments:—To my electro-magnetic machine, which was driven by a Brayton petroleum oil engine of five-horse power, wires were connected for conveying the electricity produced to a room some 300 feet distant, from which daylight could be excluded, for photometric experiments. In this room, the wires were connected with a Foucault regulator for the electric light, the light being produced by the passage of the electric curve between two carbon points. The electric light being too brilliant for direct comparison with the standard candle, I took from my house a common coal oil lamp, having a flat wick 1 inch wide. The electric light was found to be equal to what would have been produced by 234 such lamps. But 234 such lamps would have consumed nearly 16 lbs. of oil per hour, while the engine, whose power developed the electric current, which in turn produced the electric light, consumed but 6¾ lbs. of oil in the same time. This fact was stated in the paper giving the results of my experiments, merely as showing, in a striking manner, how very small a proportion of the energy of combustion of the oil in the common lamp is utilized as light."

Miscellaneous News.

METROPOLIS GAS SUPPLY.

The Alleged Nuisance at the Haggerston Gas-Works.

The Vestry of St. Leonard's, Shoreditch, having addressed a letter to the Board of Trade, complaining of a nuisance caused by the operations of The Gaslight and Coke Company, at their Haggerston station, in the purification of gas by lime, the matter was submitted by the Board to the Gas Referees for inquiry and report, and the Gas Referees have made the following communication to the department:—

"17, *Buckingham Street, Adelphi, W.C., Nov.* 22, 1876.

"Sir,—We have inquired into the causes of the gas nuisance in Haggerston, to which our attention was called by your letter of the 20th of October and the letter and report enclosed therewith from the medical officer and vestry-clerk of St. Leonard's, Shoreditch.

"We have paid two visits to the Shoreditch gas-works, and have witnessed there the discharging of a lime purifier, which is the operation stated in the above-mentioned report to be the cause of nuisance.

"During a part of the time occupied in discharging the purifier, we made a circuit of the immediate neighbourhood of the gas-works, and observed in what positions and to what extent the smell of foul lime was perceptible. We also inquired of occupiers of houses or shops at short intervals throughout the circuit, whether they had suffered any nuisance from the neighbourhood of the gas-works, and if so, at what times.

"Our own observations showed that the foul lime smell was perceptible, on the side towards which the wind was blowing, at some distance from the works; and we believe that it may be carried to a considerable distance—probable half a mile or more—before it ceases to be recognizable. At the same time the smell was not, in our judgment, very offensive even close to the works, and the statement in the report, that 'the gas which is given off when the tanks are opened is a most foul, offensive, and dangerous poison,' is not in accordance with anything that we have observed at Shoreditch or elsewhere.

"The questions addressed by us to persons living in the neighbourhood of the works received in most cases the same answer—viz., that three weeks ago there had been bad smells from the gas-works, but not since then. One or two persons had nothing to complain of, and one or two others had noticed a smell from the gas-works more recently. One smelt it every night, whereas a purifier is only discharged every fourth or fifth day; another thought it very bad that morning, but fixed the time at which he had first observed it, two hours before the purifier was opened.

"It seems probable that the nuisance which occurred in the middle of last month was caused by a process of ventilating the purifiers which was intended to diminish the risk of nuisance, and which it was reasonable to try. But, unfortunately, under the actual conditions of the experiment, this process seems to have caused a far greater nuisance than that which it was designed to avert. The manufacture of gas cannot be conducted without the production of a certain amount of unpleasant smell, of which the occupiers of houses in the immediate neighbourhood of the works are naturally inclined to complain. When any new process slightly aggravates the unpleasantness, an outcry is easily excited; and when the process is one which the company have reluctantly adopted in lieu of a less costly and troublesome, but also less efficient, process, and when the local authority, as in the present case, simply accepts and records the opinions of the company's engineer, it is inevitable that the evils of the process should be exaggerated as they undoubtedly are in the Haggerston report.

"According to the best judgment we can form, the process of purification by lime, as now conducted at the Shoreditch works, can scarcely be considered to occasion a nuisance to the neighbourhood in which the works are situate, and we think the risk of nuisance may be further reduced by additional precautions.—We are, Sir, your obedient servants,

(Signed) "A. Vernon Harcourt.
"William Pole.
"John Tyndall.

"The Assistant Secretary, Railway Department, Board of Trade."

METROPOLIS WATER SUPPLY.

The following are the returns of the Society of Medical Officers of Health, on the composition and quality of the metropolitan waters in December, 1876:—

Names of Water Companies.	Total Solid Matter per Gallon.	Oxygen required by Organic Matter, &c.	Nitrogen.—As Nitrates, &c.	Ammonia. Saline.	Ammonia. Organic.	Hardness (Clarke's Scale). Before Boiling.	Hardness (Clarke's Scale). After Boiling.
Thames Water Companies.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Grand Junction	20·76	0·128	0·165	0·003	0·009	13·2	3·8
West Middlesex	22·61	0·100	0·165	0·006	0·009	14·3	4·6
Southwark and Vauxhall	21·14	0·114	0·150	0·002	0·008	14·3	4·6
Chelsea	19·18	0·132	0·135	0·006	0·010	12·1	4·6
Lambeth	19·46	0·110	0·150	0·001	0·007	12·7	4·6
Other Companies.							
Kent	26·73	0·007	0·216	0·000	0·002	19·4	5·1
New River	19·28	0·092	0·160	0·000	0·004	14·3	4·2
East London	23·21	0·052	0·135	0·002	0·006	15·4	3·4

Note.—The amount of oxygen required to oxidize the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

The water was found to be clear and nearly colourless in all cases but the following, when it was slightly turbid, namely:—Grand Junction, West Middlesex, Southwark and Vauxhall, Lambeth, Chelsea, and East London.

C. Meymott Tidy, M.B.

GLASGOW STREET LIGHTING.

In our "Trade Notes from Scotland," on the 19th ult., it was stated that the sub-committee appointed by the Watching and Lighting Committee "had submitted an interim report on the comparative merits of various kinds of gas-burners for street lighting; and the committee, having considered the same, agreed to recommend that the inspector of lighting be instructed to remove all rat-tail burners from the public street-lamps, and substitute burners consuming not less than two cubic feet of gas per hour, and directed the sub-committee to continue their experiments and to report further. A good deal of discussion ensued in reference to this minute, and the report was remitted back to the committee."

The *Glasgow News* states that, at the fortnightly meeting of the Police Board, on the 25th ult., the Watching and Lighting Committee brought up their minutes, from which it appeared that, with reference to the minute of last meeting regarding increased street lighting, the inspector of lighting *ad interim* reported that there were at present in use in the street-lamps about 5200 rat-tail burners; the cost thereof for gas, at the present rate (15s. 6d. per annum), would be about £4030, and if burners consuming two cubic feet of gas per hour were used instead, as proposed, the cost for gas would be double.

Treasurer Osborne, in moving the approval of the minute, said he might confess to the board that the committee were still in darkness on this subject; but one thing they had arrived at—namely, to recommend that the streets should be lighted with jets burning two feet of gas per hour The increased cost was estimated at about £4000 per annum, but they had reason to believe that it would not amount to anything like that sum. The special committee were still making inquiries, and scientific experiments were being made; but they were not yet in a position to determine what plan they would ultimately adopt. There was one principle they should always adopt—namely, they should do their work well, and they should light the town well.

The Chairman (Bailie Collins) was not very clear as to the meaning of this minute. He was at one with the committee that the rat-tail burners should be removed, but the committee got authority to do that on the 15th of September. He had failed to obtain information why that minute, which provided for an increase in the lighting of the city to the extent of 30 per cent., had not been carried out. They were told that the reason why Horton's burner, then recommended, had not been introduced was that each burner cost 4d. instead of 2d.; but he held that the first cost of the burner was as nothing compared with the maintenance. He wished them to understand that the increased charge of £4000 would entail an additional tax of ¼d. in the £1, and were they prepared for that? He thought that this subject required more consideration, and moved an amendment to that effect.

Mr. Osborne read a letter which the Lord Provost had received, as to the Edinburgh gas. The burne which consumed 2 feet per hour cost 3s. 10d., and the others which burned one foot per hour, by a regulator, also cost 3s. 10d. He, however, remarked that the small burners were better than the ones used in Glasgow, while the large ones were not quite so good.

Bailie Adams seconded the amendment.

Mr. Ure, after referring to the various kinds of burners which had been before the board, said the question was not so much one of burners as one of lighting the streets. They had found, on examination, that the regulators on the lamps were altogether unreliable; for out of eight which they tried four were altogether unreliable, in some cases burning one-half more gas than they ought to have done. Indeed, it was a question whether they should not burn gas in the lamps without regulators. He was prepared to prove that the present gas lighting was altogether insufficient. They paid far less for the lighting of the streets than did second-rate cities in England, and he was almost prepared to prove that they got less than they paid for. They had 8010 public lamps at a cost of £8600, or about an average of 21s. 6d. per public lamp, while their population was about 550,000. In Manchester they had 10,762 lamps, costing £18,823, or an average cost of 35s. per lamp, and that, too, with a population of 200,000 less. In Leeds, with a population of 291,000, they had 6000 public lamps, at a cost of £12,000, or an average of 40s. each. He would like to draw their attention to another fact—that while in Leeds, with a population of 291,000, and spread over a much larger tract of ground, there were only 340 policemen; in Glasgow there were fully 1000, and it had been said a lamp was better than two policemen. Another thing was that about 4000, or one-third, of the whole of the lamps in Glasgow were paid for by private individuals. He, therefore, suggested that, while the central parts of the city were well lighted, additional light should be thrown upon the residential part, as it was in the quiet streets that there was a great deal of concealed crime.

Mr. W. Miller said the question they had to deal with was the 5200 rat-tail burners. These at present cost £4030, and if a burner which consumed only a foot of gas per hour cost that sum, another burning 2 feet would cost £8060. It was, therefore, for the board to fix what increase they proposed to make. For that sum they would get more than double the light in those places where the rat-tails were at present, and it was well known that these included about five-eighths of the whole of the lamps in the city. He contended that the committee were just as able to judge of that matter as the board, and concluded by seconding the motion for the adoption of the minutes.

Bailie Scott mentioned that in the report presented to the board in September last they were promised double the light at an additional cost of £1200 per annum; and the question before the board was whether they would now pay £4000 for that double light or £1200. He concurred in the suggestion which had been thrown out, that the streets where the additional light was to be placed should be selected—especially those places where crime was possible and even probable—and if that arrangement was carried out a great deal of money might be saved to the city. He would hesitate very much before he would agree to a taxation of an extra halfpenny per pound.

Mr. W. R. W. Smith supported the statements of Mr. Ure, and remarked that if the board should agree to burn an additional foot of gas per hour in the lamps, they should leave the sub-committee to try and find out the best and cheapest burner. He maintained that it was from Dr. Wallace that Mr. Foulis obtained his data, and it was from him the board ought to seek direction in a matter of this kind. He supported the motion.

Bailie Lamberton contended that the town of Leeds was spread over a much larger area than Glasgow, and that according to the ground occupied it was not so well lighted. Indeed, he did not know any city so well lighted as Trongate, and he also thought more light would be obtained by adopting the square instead of the round lamps.

Bailie Walls said there were two questions in connexion with this subject which required attention—namely, that of the regulators and that of the burners. They were not all at one on the subject of the burners—Dr. Wallace and Mr. Foulis were not at one—and he thought an effort should be made to ascertain which was the best and most efficient burner that could be adopted. He was quite willing that the minute should be adopted on the condition that the rat-tail burners be used until it was definitely ascertained which was best.

Mr. Moir considered that it was absurd to suppose that a square lamp would give more light than a globe. He was also satisfied that more information was required, and he did not agree with those who seemed to think that some dreadful calamity was certain to happen unless more light was given. There were a greater number of embezzlements and robberies during the sunlight than during the darkness; and immorality would exist, although light was abundant in the streets, just as it did in the darkness. He thought, therefore, that the subject should be fully considered before any action was taken.

It was ultimately agreed that the minute be approved, but that the question with reference to the burners to be used should be remitted to a joint committee of the Police Board and the Gas Commissioners to ascertain which is the most efficient burner that can be used instead of the rat-tail.

GLOUCESTER NEW GAS-WORKS.

[From the *Gloucester Chronicle.*]

The growth of Gloucester, which has been going on rapidly during recent years, necessitated an enlargement of the old line of the borough boundaries, so as to take in the suburban extensions which had been spreading in almost every direction. By this step the population of the city was about doubled, and the area of Gloucester more than trebled. In the face of these prospective changes the quiet old "Gloucester Gaslight and Coke Company," with their small works in a thickly-populated neighbourhood, were fully conscious they could not properly respond to the requirements of the enlarged city, and that the erection of extended works was imperative. The Local Board of Health insisted that the company should remove their works from the present site, and so in 1872 this prosperous company decided upon the erection of new works upon a commodious site beyond the city boundaries, where there would be "ample room and verge enough" to manufacture gas, with all improved modern appliances, without annoyance to neighbours. To do this it was necessary for the company to apply for a new Act, and in it they obtained powers to increase their capital by the issue of new shares, and also to borrow additional capital. Under the pressure of the Local Board the company undertook to close the manufacture of gas at their present works in the city within a period of eight years from the passing of their Act, unless with the permission of the Local Board. The Royal Assent was given to the Bill in May, 1872, so that of this period five years will have elapsed next May. There is, however, no fear but that the new works will be in full operation long before the date fixed for the closing of the old works.

The most favourable district which offered itself for the new works, as presenting facilities for the requisite water communication, was that bordering the Bristol Road—a dead level, with the ship canal on one side, and the two great railways, the Midland and the Great Western, on the other. In selecting the site, the company were naturally desirous of not going too far out into the country, as, besides the increased cost of mains, the working expenses would naturally be heavier the farther the works were removed from the coal-supplying and coke-consuming city. The piece of land known as the "Exhibition Field," where the Royal Agricultural Show was held in 1853, was first pitched upon as being most desirable, and application was made to the owners, the Ecclesiastical Commissioners, who sent down a surveyor. On his report, however, they decided they could make a better bargain with their land if it were reserved for building purposes, although the gas company would have given £300 an acre; and the commissioners soon afterwards expended a large sum in the construction of a road uniting the Bristol with the Tuffley roads. Two fields near the back of this spot were next considered, but as works on this site would be in full view of Hempsted Court, Canon Lysons threatened parliamentary opposition, and offered the company land further out, at a much less sum. As the threatened opposition, with this fact before the Parliamentary Committee, might have succeeded, the company decided upon accepting the offer, and 10½ acres of land were agreed to be taken, with a lie-by on the other side of the road along the canal, which the canal company agreed to allow the gas company to construct, with a tramway running across the high road from the company's works. Plans for the new works were prepared by Mr. Morland, the engineer of the company, who has designed the whole with a view to carry out all modern improvements in gas manufacture. Tenders were invited for the construction of a portion of the works, which it was intended to complete before they are extended to their full capacity. Unexpected difficulties, however, had arisen. The strikes which had taken place, and the advance in the price not only of manufactured articles, but of raw materials, caused a suspension of the works. Had their construction been at once proceeded with, the price of iron, &c., would have greatly increased their cost, and thus the company would have been saddled with a heavier perpetual charge for interest. In the summer of 1873 the excavation for one of the gasholders was commenced, and the clay extracted was found to be admirably adapted to the manufacture of bricks, each thousand requiring about three cubic yards of clay. The price of iron having fallen, the laying of the necessary mains, &c., was proceeded with; the difficulties, however, before referred to, with others which pressed heavily upon Mr. Meredith, who commenced a contract in February of last year, more especially those connected with the price of labour, compelled him to throw up his contract, and the company then took its completion into their own hands, and the work has since been steadily progressing. It is, however, yet far from completion, but in consideration of the importance of the works, and to satisfy the public that Gloucester will have its new gas-works all in good time, we proceed to give a sketch of them as they are intended to be when completed, with an account of the progress made up to the present time.

The site of the works is on the left-hand side of the Bristol Road going from Gloucester, a short distance past the Hempsted Bridge. The complete works will comprise four gasholders and four retort-houses. A road will run through the centre of the works, on each side of which the gasholders will stand. Only one gasholder and one retort-house have yet been erected. The tank containing the gasholder is 35 feet in depth and 132 feet in diameter. It has been lined with bricks, about 800,000 having been used. In digging out the enormous mass of clay, which is the blue-lias of the district, only a few of the ordinary fossils were found—namely, ammonites and gryphæ. From the clay thus obtained over two million bricks have been made, and enough remains for another million. Most of the clay came out in a shaly state. It was crushed by being passed between rollers, and was found, without any admixture, to make good ordinary bricks. Owing to the difficulty of keeping the brickmakers to their work, a brick-making machine has been introduced, and has worked well, making the bricks with great certainty and speed. The gasholder is what is known as a single lift, and will hold nearly half a million cubic feet of gas. This will be sufficient for present requirements, while the gasholders of the old works continue to be utilized. The first of the four retort-houses will contain 168 retorts, comprising 28 beds of six in each. Patent lids will be used for the retorts, by which luting is rendered unnecessary. The house is 150 feet long and 62 feet wide. This great width will give ample room for working the retorts, and will materially conduce to the comfort of the men by reducing the heat and allowing of more ventilation, while space will be afforded for the introduction of machinery for filling and emptying the retorts, should such be decided upon. At the end of the retort-house is a circular chimney-stack, 90 feet in height, and 5 feet 6 inches in the clear. This is so built as to be wider inside at the top than at the bottom, by which increased draught is secured. It is being fitted with a copper-wire lightning conductor. Near this is the stokers house, with outhouses adjoining, and large coal-stores will be constructed by the side of the retort-house. The gas leaves the retorts by pipes leading to a main, which conducts it, with all its impurities, to the condensers, which are not yet put up, though the material is on the ground. The tar, &c., which results from the cooling of the gas, will run along pipes into a huge tar-well, which has been sunk in the ground, and which will hold about 60,000 gallons. A new apparatus, known as the steam-jet exhauster, will be employed to draw the gas from the retorts, and along through the series of pipes and apparatus by which it is purified until it reaches the gasholder. After the gas has passed through the condensers, it is subject to what is known as the "scrubbing" process, the gas being brought into contact with water, which descends in a shower, carrying with it the ammoniacal and other impurities with which it is charged. These scrubbers are now in process of construction. The gas next undergoes the process of purification and revivifying, passing on to the purifiers, of which four have been erected. Externally they resemble gasholders. They are made of iron, and are each 24 feet square, which is double the size of the old ones. Inside these purifiers will be placed a number of wooden perforated trays, loaded with oxide of iron and occasionally lime, and the gas being forced through successive layers of these materials, the sulphuretted hydrogen which it contains is absorbed by the oxide, and the carbonic acid, which, however, is scarcely considered an impurity, is absorbed by the lime. Any deficiency of illuminating power resulting from the presence of carbonic acid can, however, be generally more cheaply repaired by the use of a little cannel coal in mixture with the ordinary coal, and then the oxide can be used alone in the purifying process. The oxide of iron used for this purpose comes chiefly from the bogs of Ireland, where it is known as bog ochre. The oxide can be used for some time, and after being exposed to the air and turned over it can be employed 30 or 40 times before it becomes so saturated with sulphur as to be useless for gas purification. It is, however, then useful to the sulphuric acid manufacturer, into whose hands it is transferred. These purifiers are ingeniously constructed, so as to allow of their being easily charged and emptied. The cover of each of them, which weighs about five tons, is made to traverse a tramway, and by means of a small hydraulic apparatus one man can easily raise and remove it. A novelty has also been introduced in the method of joining together the iron plates of which these purifiers are built. Instead of a caulking of iron rust being placed between the plates, which was the old method, the plates are first planed smooth, and they are then screwed up tightly together without the possibility of leakage. A shed will be erected over these purifiers and over other apparatus in the different portions of the works. When the gas is thus purified, and rendered fit for consumption, it passes on through the meter to the gasholder. This meter will be capable of passing and registering 40,000 feet of gas per hour; but arrangements are made for adding another meter. The next gasholder which will be constructed will be placed between the present one and the road. It will be on the telescope principle, and will hold double the quantity of the existing one. Two others of the same capacity as the present may be constructed on the opposite side of the road which passes through the works. The storeage capacity of the four gasholders will be over three million cubic feet. The second retort-house will be constructed at the back of the present one, and the two others in corresponding positions on the other side of the road through the works; they will be connected in front probably by coal stores, &c., with a clock facing the Bristol Road. The works when fully completed will be capable of manufacturing three million cubic feet of gas per day, which is about five times the present make. The lie-by which has been formed on the bank of the canal is 200 feet long, with a depth of 15 feet of water. It has been built in a most substantial manner. A tramway will run along its whole length, and will furnish every facility for landing coal, &c., and the removal of tar and coke. It would, however, be a great advantage if the company could obtain a siding into their works from the Midland and Great Western lines at Tuffley, a desideratum which may perhaps be obtained when the Littleworth level crossing having become unbearable, the dock line will be diverted from its present route across two much-frequented roads by the Park and Spa, to the banks of the canal, and across the Bristol Road to a junction at Tuffley. The works at present being carried out also include a pair of boilers and chimney-stack, which are built (one being a duplicate in case of accident), with engine-house, &c., and four cottages for men engaged on the works, whom it is desirable should be at hand. This feature of duplicating the apparatus is largely employed in other portions of the works. A house for the manager and engineer, Mr. Morland, has also been built adjoining the road, and some stables and other requisite buildings are constructed. Owing to the thickness of the clay soil no water has been found in the deepest excavations that have been made; consequently tanks have had to be built for the collection of rain water for the houses. A well is to be constructed, which will be filled from the canal. This will supply a cistern, from which water will be conducted into the retort-houses and wherever it may be required. At the entrance to the works, just inside the gates, will be on one side the gatekeeper's house, weighing machine, &c., and on the other the test-house, experimental room, &c., with the governor for regulating the pressure of the gas as required. Gas-mains of 24 inches diameter have been laid to the Bristol Road; from the works up into the city and through the chief streets the diameter of the main is 18 inches, and provision is made for carrying another 18-inch main when necessary. In carrying out this work many obstacles were encountered, not the least being the lines of sewerage which had to be intersected. But all these were promptly met and successfully overcome by the engineer, who deserves no little credit when it is remembered with what nicety gas-mains have to be laid in regard to their levels, with due arrangements for intercepting and drawing off the water which condenses from the gas, for which receptacles are made below the level of the mains. It is expected that the works will be sufficiently complete to commence working early next summer.

ENRICHERS.

[From the *American Gaslight Journal.*]

It is proposed to give our readers some results obtained by using Mr. Farmer's "Candle Feet" formula, in determining the relative values of different "enrichers," in the manufacture of gas from ordinary caking coal. The gas maker is constantly under pressure of one kind or another to adopt this or that kind of coal, or oil, or naphtha, in his works. Often his decision is made from a general idea that "there is no saving in it," or that "it is profitable," without having any well-established facts to base his opinion upon. Sometimes necessity forces the use of materials which are the best to be had, although it is known that others, if obtainable, would be better.

In this statement, for the purpose of a fair comparison, certain things must be assumed as a basis of calculation, as, for instance, the price of coal, naphtha, or petroleum, which, from its very nature, is a variable quantity; but, if our figures are right for one price, they can easily be adapted for different prices.

By enrichers we mean anything mixed with or added to the ordinary caking coals, whereby the yield may be increased without lowering the quality and candle power of the gas. The most common enrichers, and the most generally available, are cannel coal, and either petroleum or some of its products. There are some minerals known as the Ritchie mineral, the Australian shale, and the "Albertite," which have great value as enrichers, but they are unfortunately scarce, and consequently high-priced. It is understood that the Boston Gaslight Company now use what little "Albertite" there is, and have obtained some excellent results from it. The other two varieties are not in the market. The ordinary cannels in general use in the East are the Kanawha cannels, such as the Cannelton and Peytona. The most common caking coals are the Penn

and the Westmoreland, and, using these as the basis, it is proposed to examine the relative value of the others as enrichers—for the purpose of making an 18-candle gas, with a yield of 4·66 cubic feet to the pound, or, in other words, to make a gas giving 84 candle feet.

Petroleum.—From the best experiments that have been made it has been found that petroleum will yield 70 cubic feet of 70-candle gas per gallon. In practice it is believed that the experimental results cannot be obtained invariably, or fully, on a long working, and that the value of the gallon of petroleum will not exceed 55 or 60 cubic feet of 70-candle gas; but, for the purpose of this paper, we will assume the experimental value to be correct. A gallon of petroleum weighs about 6·6 lbs., or 339·4 gallons = 1 ton of oil—which, at 15 cents per gallon would cost 50·85 dols. One ton of oil yields $(2240 \times 70) \div 6{\cdot}6 = 23{,}757$ cubic feet of gas, or 10·6 cubic feet per lb., which would give us for the "candle feet" of petroleum $-10{\cdot}6 \times 70 = 742$.

Naphtha.—One gallon of naphtha will yield 60 cubic feet of 60-candle gas, weighs about 5·5 lbs., or 406·3 gallons = 1 ton of naphtha which, at 10 cents would cost 40·73 dols. A ton of naphtha then would yield $(2240 \times 60) \div 5{\cdot}5 = 24{,}436$ cubic feet of gas = 20·9 cubic feet per lb., and its candle feet would $10{\cdot}9 \times 60 = 654$.

Albertite.—This is a very rich mineral, and perhaps its full value is not yet determined, but owing to the fact that the supply is limited, it is not of so general an interest as it otherwise might be. Experiment has shown that, for a yield of 15,000 feet per ton (6·69 feet to the lb.) it will give a 58-candle gas. This is believed to be a low estimate, but, nevertheless, this having been undoubtedly obtained; we take it on this basis, which would give us for this enricher 388·02 candle feet. It costs about 23 dols. per ton.

The Kanawha Cannels.—These are coals well known in this market, and their value is variously estimated; but we deem it perfectly fair to assume that they will give, upon a yield of 5 feet to the pound, a 40-candle gas. We are aware there is a difference in the value of the coals according to the kind, the method of marketing, and the exposure to which they are subjected; but for a general discussion the above value is taken, because it is known that they will give that in practical working when tolerably fresh-mined So that for these cannels we have 200 candle feet.

Caking Coals.—For the basis of our mixture we take either the Penn or Westmoreland coal, which are very nearly identical in quality, and will ordinarily give 4·25 feet of 16-candle gas—hence the candle feet will be 68. From the above we have the following table of candle feet and price:—

	Candle Feet.	Price per Ton.	Remarks.
Petroleum	742	50·85 dols.	15c. per gall.
Naphtha	654	40·70 „	10c. „
Albertite	388	23·00 „	—
Kanawha cannels	200	10·00 „	—
Penn and Westmoreland.	68	6·00 „	—

For the purpose of determining the cost of materials for mixtures, let us assume the above values of candle feet and cost as correct.

Taking a mixture of 5 per cent. of Albertite and 95 per cent. of Penn, what will be the yield if 18-candle gas is made?

$$\cdot 95 \times 68 = 64{\cdot}60 \text{ candle feet of Penn.}$$
$$\cdot 05 \times 388 = 19{\cdot}40 \text{ candle feet of Albertite.}$$
$$84{\cdot}00 \text{ candle feet of mixture.}$$

Now, if this is 18-candle gas, from the definition of candle feet, we have a yield of 4·66 feet to the pound—as $84 \div 18 = 4{\cdot}66 +$. If the yield was increased to 5 feet per pound, the candle power would be $84 \div 5 = 16{\cdot}8$ candles.

Let us now find what per centage of naphtha would have to be used to obtain the same amount of equal gas; *i.e.*, using Penn coal, how much naphtha must be used as enricher to give us a mixture of 84 candle feet = 4·66 feet to the pound of 18-candle gas.

Let x = per centage of naphtha, then
$(100 - x)$ = per centage of caking coal
$654x$ = candle feet of per centage of naphtha
$(100 - x)\ 68$ = candle feet of per centage of caking, from which we have the equation

$$\frac{654x + (100 - x)\ 68}{100} = 84$$

As the sum of the candle feet of the parts of the mixture must equal the candle feet of the mixture, which is to be 84—solving the equation, we have $x = 2{\cdot}73$ = per centage of naphtha, and $(100 - x) = 97{\cdot}27$ per centage of Penn.

Proof—

$$654 \times \cdot 0273 = 66{\cdot}143$$
$$68 \times \cdot 9927 = 17{\cdot}854$$
$$83{\cdot}997 = 84 \text{ candle feet of mixture.}$$

Having determined the relative amounts of the two enrichers necessary to produce the same gas, let us now see what is the relative cost of the materials.

1. *Penn and Albertite.*

0·05 ton of Albertite at 23 dols. = 1·15
0·95 ton of Penn at 6 dols. = 5·70
1·00 ton of mixture 6·85 dols.

The Albertite yields 15,000 feet of gas per ton, and the Penn 9520 feet.

·95 of 9,520 . . . . . = 9044 gas from Penn.
·05 „ 15,000 . . . . . = 750 „ Albertite.
Total yield of mixture . . . 9794

$$\frac{6{\cdot}85}{9794} = 69{\cdot}9 \text{ cents, cost per 1000 Penn and Albertite mixture.}$$

2. *Penn and Naphtha.*

·0273 tons of naphtha . . . at 40·70 dols. = 1·11 dols.
·9727 „ Penn . . . . „ 6·00 „ = 5·84 „
Cost of mixture . . . . . 6·95 dols.

·0273 of 24,436 . . . . . = 667 = gas from naphtha.
·9727 „ 9,520 . . . . . = 9260 = „ coal.
Total yield of mixture . . 9927

$$\frac{6{\cdot}95}{9927} = 70 \text{ cents, cost per 1000 of Penn and naphtha mixture.}$$

From which it would appear that the cost of the materials, for the gas made from the two mixtures, is about the same on the basis assumed.

By a similar course, it will be found that 2·37 per cent. of petroleum, and 97·63 per cent. of caking coal, will give 84 candle feet; that the cost of the materials will be 7·06 dols. per ton, the amount of gas made 9857 feet, which will make the cost of materials for 1000 feet equal to 70·6 cents.

Using the Kanawha cannels, by the same kind of calculation, it will be found that the per centage of cannel necessary is equal to 12·12, and the per centage of caking coal 87·88; that the cost will be 6·48 dols. per ton, the yield 9723 feet; and the cost per 1000 feet for the materials will be 66⅔ cents.

Table of Mixtures giving 84 Candle Feet.

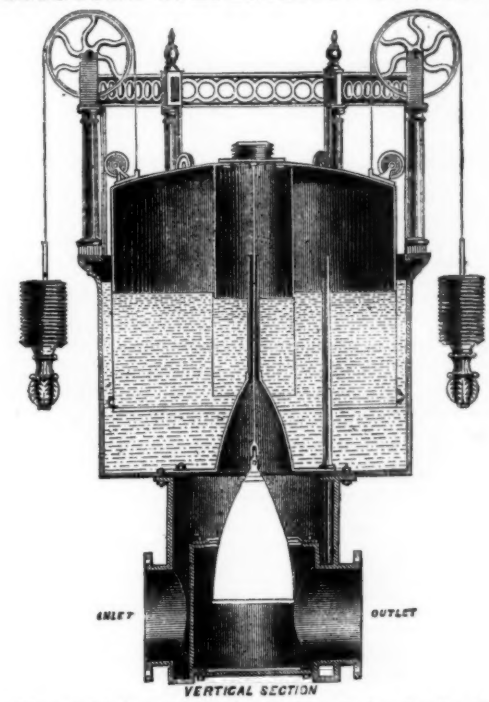
Enrichers.	Per Cent. of Enricher used.	Per Cent. Caking.	Cost per 1000 Feet for Material.
Petroleum*	2·37	97·63	70⅚ cents.
Naphtha†	2·73	97·27	70 „
Albertite	5·00	95·00	69⅔ „
Cannels	12·12	87·88	66⅔ „

* 15 cents per gallon. † 10 cents per gallon.

The question of cost is considered only with reference to the purchase of the materials, not deducting for coke and other residuals. When oil is used, the coke will be diminished not only by the amount that would be obtained by using coal, but also by the amount used as fuel in distilling the oil.

It takes 7½ bushels of coke to convert 42 gallons of oil, or 72½ bushels for one ton of oil. One ton of coal can be carbonized by about 18 bushels of coke. We believe that this method of comparison is a correct one, and it certainly gives results that correspond very closely with actual workings.

BRADDOCK'S COMPENSATING GOVERNOR.



The object of this invention (which has been designed and patented by Messrs. J. and J. Braddock, of the Globe Meter-Works, Oldham) is to regulate and govern the flow of gas in pipes, for the purpose of maintaining an uniform pressure at the outlet of the governor, under all the various changes of the flow of gas, when such flow is not in excess of the capability of the size of the governor, and the quantity of gas it is made to control.

The class of governor to which the invention applies principally is that in which a bell floating in water is caused by the pressure of the gas to raise or lower a conical or other plug bedding against a valve-seat, thus regulating the supply, and keeping it of an even pressure.

In operation, the gas is caused to flow in such a direction that its tendency is to open or depress the plug or valve, and in order to counteract the effect of the varying inlet pressure on this plug, there is constructed within the bell a compensating chamber, the area of which is equal to that of the plug, and communicating with the gas at the inlet pressure. Thus, the pressure tending to raise the bell and depress the valve being equal, an equilibrium is maintained.

The main part of the bell is connected by means of a pipe to the gas in the main or at the outlet pressure, and the bell itself being weighted or counterbalanced accordingly, this outlet pressure will be steadily maintained, however the inlet or initial pressure may vary.

It will, of course, be understood that the initial pressure must in all cases be greater than the outlet pressure required.

From the engraving it will be seen that only the gas required to operate the bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. It is also apparent that in case of accident to the bell no more gas can escape than would pass up the pipe covering the valve-rod and bell supply-pipe.

These governors have been made and sent out of various sizes, for from 2 to 24 inch mains, and give most satisfactory results. They can be made with float in the bell, or counterpoise, as per section.

The invention is also applicable to dry governors, by connecting the compensating chamber by means of a diaphragm.

ON ANTHRACENE PRODUCTION.

By Dr. Frederick Versmann.

[From the *Chemical News.*]

My investigation on anthracene testing, published in the last three numbers of the *Chemical News*, has brought me many inquiries and communications, which induce me to supplement this purely scientific investigation, and its practical application, by some remarks on the commercial aspect of anthracene manufacture generally; and I do so simply because I think my information may enable me, perhaps, to throw some light upon this important question, and also because a crisis in this manufacture seems to become inevitable, and that at no distant time; the serious consequences of which it may well be worth while to weigh and to consider beforehand.

We all recollect the profound sensation created by the grand discovery of artificial alizarine and its manufacture on the largest scale, which last

commenced only five or six years ago. In recalling the sanguine expectations raised by this new industry, its present dismal position appears scarcely credible, and yet the fact stands out only too clearly, that no other branch of chemical industry, inaugurated under such bright auspices, has in its results fallen so short of just expectations; nay, I might also say, has become so disastrous to nearly all persons who remained engaged in its pursuit. True, the first pioneers—those who were actually at work while the first excitement was at its height—were wise enough to sell their fortunes at prices which brought them large profits. First among these stood Messrs. Gessert Brothers, who sold their, at that time, flourishing concern to a company, and the English alizarine manufacture has since changed hands a second time.

Putting aside a very few German alizarine makers, who profess to work at a profit, we have at present a disheartening list of many large undertakings which are hopelessly insolvent, or at least uncomfortably near to it.

In Germany all public companies are very properly compelled by law to publish their annual balance-sheet in at least three newspapers, and such document—published only on the 10th Nov. in the *Cologne Gazette*—by the "*Chemische Industrie Actien Gesellschaft zu Elberfeld*," formerly Gessert Brothers, tells its own tale in a few figures. This official document informs the shareholders that the loss on the twelve months' working, ending at Midsummer last amounts to £40,000; and as this dismal statement is merely a repetition of previous equally unsatisfactory balance-sheets, there seems to be little doubt that at next month's general meeting the company will be wound up, and that very likely the whole capital —amounting to some £180,000—will be lost.

Again, a private firm, Messrs. Schœneberg and Hufschmidt, also of Elberfeld, recently suspended payment, with liabilities estimated at £90,000, and assets £60,000, or a deficit of £30,000.

The "Stueckfärberei Gesellschaft" and the "*Elberfeld Aniline und Alizarine Gesellschaft*," also joint-stock companies, have been defunct for some time, their capital having been entirely lost.

Plain facts like these—and the list might easily be made more complete —may well lead to an inquiry into the cause of such calamity. It may be justly argued that bad management, want of skill or proper knowledge in the manufacture, and, above all, the general depression in all trades, especially in the cotton trade and everything depending upon it, have a great deal to do with the non-success of so many undertakings; but I believe the real and primary cause to be the most unhealthy state of the anthracene manufacture.

The fact is the production of anthracene far exceeds its demand, which, suddenly sprung up some years ago, tempted many distillers to manufacture an article of a very doubtful quality; competition unreasonably ran up the price of tar, and the principal benefit was pocketed by the gas companies, and by them alone.

I am induced to give a few figures which will clearly show this disproportion, and which, I feel sure, will be very near to the actual truth, because I have every reason to depend upon their correctness.

Up to the end of 1877 there will be produced in England alone, including present stock, at least 1400 tons of pure, or 100 per cent., anthracene. The requirements of all the alizarine works at present do not exceed 2 tons a day, or 600 tons a year, of pure anthracene. The next year is expected to see a considerable increase; but if with present low prices we even double the quantity—making it 1200 tons—England alone will produce 200 tons of pure anthracene more than required.

But it must not be forgotten that the Continent also supplies large quantities. The Paris Gas Company utilize their own residues, and produce, together with the other large French towns, at least 250 tons. Belgium—and, more so, Holland—is very active; and the production in Germany, especially in large towns—such as Berlin and Hamburg—is not inconsiderable; and even America sends her quota, if not in large quantities. Altogether there will be during 1877 an excess of many hundreds of tons of pure anthracene, and, consequently, low prices. The inevitable reaction will produce a reduction in the price of tar, which already shows itself in Germany. A paper there offers repeatedly, and for some time, six tar contracts, without any response; the distillers bide their time, and their English brethren will soon find out, if they have not done so already, the necessity of this line of action.

But—and here I come to the main point of my argument insisted upon in previous communications—the tar distiller must feel to find his advantage in the manufacture of a better and purer article. He must return to the early times of his operations, when with low tar prices a moderate price for anthracene paid him well.

The large stock accumulating during 1877 may somewhat interfere, but after that the permanently reduced prices of tar will enable him to supply genuine anthracene at paying prices.

It is well known that true, pure anthracene passes over at a certain limited stage of the distillation, and this product only was originally sold; the suddenly increased demand for large quantities induced the distiller to separate as much solid hydrocarbons as possible, and thus the quality of anthracene deteriorated to such a degree that any article tested by alcohol, and showing a melting point of 190° C., was sold as anthracene. The increasing impurity of the merchandise called forth improved methods of analysis, until at last the chemist is obliged to demonstrate, by more delicate tests, that most of the anthracene at present in the market is of a very doubtful character.

I think the tar distiller may well bear this in mind, because, upon the good quality of anthracene, to a great extent depends the future existence of the alizarine manufacturers; and the more flourishing these, the better will be the prices of anthracene.

WATER SUPPLY OF NEW YORK.

A correspondent of the *Standard* furnished, in a recent communication to that paper, some interesting facts in connexion with the water supply of New York city. According to his statements it appears that three months ago there was experienced a considerable deterioration both in the quality and the quantity of the supply. The Murray Hill or main city reservoir was only half full, the summer and autumnal droughts having been almost unparalleled in that latitude. The usual daily allowance to the city of 100 million gallons had been reduced to 70 millions, which, certainly, but for the existence of enormous waste somewhere, ought to have been amply sufficient for the needs of the inhabitants, seeing that the average daily supply to London by the various water companies is only about 122 million gallons. The *Standard* correspondent states that "the enormous consumption of water in New York comes from wastes—waste in factories, where thousands of gallons are recklessly used where tens ought to suffice; in bar-rooms, hotels, drug stores, and many residences, where the water is kept constantly running.

"The setting in of winter promises to refill the lakes, the reservoirs, and the city pipes; but they are low yet. The water-rents in the city vary from 4 dols. to 2700 dols. a house. There are about 55,000 buildings that pay from 4 to 10 dols. rent a year, about 19,000 that pay from 11 to 20 dols., and a thousand paying larger sums; so that there are some 75,000 buildings whose aggregate water-rents are 800,000 dols. Thus, a liberal supply of water is liberally paid for. There are no meters used here, and the tax is levied by the number and size of taps in the building. A tap may be kept running 24 hours a day, and many rent-payers seem to keep theirs so running in order to get the full worth of their money.

"It is the policy of the Department of Public Works of this city to provide against the possibility—so far as human foresight can do so—of another water famine. There are now five reservoirs—the Murray Hill or 42nd Street, the old one in Central Park of nearly 150 million gallons capacity, the new receiving one in Central Park of about one billion (1000 millions) capacity, the Croton reservoir at the head of the aqueduct of 500 million, and, finally, the storeage reservoir at Boyd's Corners, estimated at about 2700 million gallons; making a total reservoir capacity of some 4350 million gallons. A new storeage reservoir is nowin process of erection with a capacity of 3650 million gallons. The aggregate reservoir capacity (counting both storeage and receiving, as well as distributing reservoirs) will, when the new one is finished, hold not far from 8000 million gallons. In addition to that there are 13 lakes or lakelets in West Chester and Putnam counties, whose united capacities amount to over 3000 million gallons. These once filled give a maximum supply on hand for two and a half months.

"The Croton watershed embraces 339 square miles, and this, with the usual annual average rainfall of 49 inches, ought to give a daily supply of 300 million gallons, as the engineers estimate. But somehow, from evaporation or other diversions, the city gets less than one-third of this at times.

"Thirty years ago—from 1842 to 1848—a daily supply of even 18 millions gave 40 gallons a day to each inhabitant, and the supply was found to be amply sufficient."

The proposals for increasing the existing supply are—1st. The construction of another aqueduct, at a cost of between 20 and 30 millions of dollars; 2nd. The utilization of the salt water of the rivers and bay for all sidewalk, sewer, water-closet, livery-stable, fire-extinguishing, street-sprinkling, and other like purposes; 3rd. To sink a thousand wells all over the city; and 4th. To tap the Hudson above tide-water level. This latter is the plan of Mr. Serrell, city surveyor and civil engineer, who thinks that for four or five millions—one-fourth of what an aqueduct would cost—engines could be constructed and put upon the Hudson, and a cast-iron pipe, about four feet in diameter, laid to one of the receiving reservoirs, all within a year, whereas four years is the estimated time necessary to get up a new aqueduct. Additional pipes could be added at a small additional cost. He holds that the water would be purer than the Croton; and, as the Croton watershed, even with two aqueducts, may fail, as it is now failing, to furnish the water needed, a new aqueduct, or a dozen new ones, would not increase the actual quantity of water.

The *Standard* correspondent mentions a fifth proposition, which involves, not the creation of a new supply, but the economical distribution of the stores already at hand. It is the adoption of meters, the difficulty in the way of which he states is a political one. "No popular politician dare advocate it, lest it cost him his popularity; for the people would oppose such a wise measure, as they oppose everything that limits what they recognize as their liberty, an unlimited and unquestioned supply of water being so considered by them. The only city in this country using meters seems to be Providence, R. I., and there the consumption is 30 gallons a day to each inhabitant — the least average known in this country."

To prove, however, that the great need of New York is not more water, but more economy, the writer quotes from the report of the Commissioner of Public Works, the following returns as to the average daily supply per head per diem in the cities as named:—

New York	95 gallons.
Chicago	80 "
Hartford	80 "
Reading, Pa.	75 "
Albany	75 "
Buffalo	63 "
Brooklyn	60 "
St. Louis	60 "
Boston	60 "
Philadelphia	56 "
Cincinnati	53 "
Baltimore	50 "
Lowell, Mass.	44 "
Cleveland, Ohio	43 "
Providence, R.I.	30 "
Milwaukee	25 "

These figures he compares with others obtained from the following European cities, on the same basis of calculation:—

Dublin	60 gallons.
Glasgow	52 "
Paris	38 "
Edinburgh	35 "
London	33 "
Liverpool	30 "
Manchester	21 "
Sheffield	20 "

We believe that in the first named (Dublin) the consumption here given is much above the actual quantity at the present time, whatever it may have been in the past; and with reference to Glasgow, the recent report of Mr. Gale, the city engineer, shows that in one extensive district, where the initial consumption had been 60 gallons per head per day, the adoption of the meter system had reduced it to 35 gallons.

Remarking upon the table last quoted, the *Standard* correspondent observes that "if these figures are correct, and the conditions as to other supplies of water the same, it is manifest that our inhabitants of New York waste an immense quantity, fully as much again as they legitimately use. In America, Lowell, a very largely manufacturing city, Cleveland, Providence, and Milwaukee, and in Europe, Paris, Edinburgh, London, Liverpool, Manchester, and Sheffield, all use less than half as much as New York does; and Providence, Milwaukee, Liverpool, Manchester, and Sheffield all use less than one-third of the same."

The following table gives some approximate figures on the same subject. The first column is of populations, and the second of gallons of water daily consumed:—

London	3,880,000	122,000,000
New York	1,200,000	104,000,000
Philadelphia	750,000	42,000,000
Manchester	750,000	16,000,000
Chicago	475,000	38,000,000
Cincinnati	275,000	15,000,000
Sheffield	265,000	5,000,000

With regard to the present works which supply New York with water, the correspondent quotes the following from a recent report of Mr. Campbell, Commissioner of Public Works:—

"These works are costly, nearly 31,000,000 dols. having been expended in this city for the present water system, and millions more must be added as the city grows in population. The charge for interest on the outstand-

ing debt, maintenance, and necessary new works is now not less than 2,000,000 dols. annually. Though the authorities may control the use of water in the streets and at docks, stables, and hydrants, and large manufacturing establishments, yet after all a very large share of the waste occurs in the interior of the 100,000 buildings which make up the city."

ON STREET-MAINS.

By Mr. W. H. Price, Ohio.

[A paper read before the American Gaslight Association, Thursday, Oct. 19, 1876.]

Perhaps no department of the complete outfit of a gas company is deserving of more wise or careful attention than that of distribution. Having secured a good field of operations, a good site for the manufacturing and storeage of his gas, and having constructed his works and his holders upon the most approved plan for producing a good article at the lowest possible cost, and properly storing the same, an adequate and well-laid network of pipes for conducting the gas to every part of his district is of prime importance to the gas engineer. Every other department may be perfect; but if this is defective, his labours will be thwarted, and his capital will be unproductive. In compliance with a request which I could not disregard, I shall proceed to offer a few practical suggestions relative to this important topic; and, in doing so, I beg that I may not be regarded as presuming to teach, but as merely endeavouring to state the views which have been impressed upon my own mind by the experience of a few years in the management of the interests committed to my care.

In determining the several points involved in a suitable system of distribution for a given town, the first thing to be considered is the size of the mains proper to be laid. The general rule to be carefully observed is this—viz., liberality in the capacity of the mains. Let the pipes be of such size that the volume of gas required shall have free course, and go forward without hindrance. By all means use such sizes of pipe that there shall be no necessity for heavy pressure, in order to give your customers a supply of gas; for excessive pressure is attended with many evils.

1. By it leakage will be much increased; and

2. The bills of consumers will be made so large as to cause complaints and withdrawals. "By doubling the amount of pressure, the consumption of gas will be increased about one-half."

If the engineer make a mistake here the evil will be serious. I will illustrate this by a case that came within my own observation. A certain gas company had pursued a narrow policy in the matter under consideration, and had laid much small pipe in the days of its poverty—some even as small as 2-inch—and when the city where it is located, about thirteen years ago, began to grow afresh, and for ten years expanded and filled up with marvellous rapidity, the gas company I refer to was pressed on all hands to extend its mains, so as to keep pace with the demand for more light; miles on miles were laid, but the chief distributing lines were neglected, and remained for years too small. They answered very well in the season when but little gas was required; they were summer sizes. When autumn and winter came, and the demand for gas became large, then a supply for remote districts could be furnished only by the application of heavy pressure, and this effect followed. The business portion of the town, near where the works were located, had excessive pressure and too much gas, while distant streets had too low pressure and too little gas. All the near by and largest consumers raised a great outcry, because their bills were suddenly nearly or quite doubled, and the more remote consumers sent in a loud cry for more light. As times became hard and economy necessary, the evil grew to be serious, and resulted in an oil war. Hundreds abandoned gas and took to petroleum; in some cases because it was cheaper, and in others because they were angry with the gas company, and wished to punish it. And it did suffer severely in consequence of the error I have described. It should be borne in mind that as winter approaches, gas bills inevitably become large, even under the most perfect system of distribution; and hence it is clearly a great error to either lay or perpetuate a network of mains so small that the bills of consumers are made excessively large at the time when they are naturally large enough for the comfort of those who collect them, thus needlessly increasing the storm, usually sufficiently unpleasant with the best system of distribution that skill and money can provide.

As to what sizes of pipe may be suitable in any given case, it is obviously impossible to speak definitely. In determining this question, everything must be considered—present needs and probable growth. In any case, I would never lay a foot of 2-inch, and but little 3-inch, even for cross connexions. It costs nearly as much to lay a 3-inch as a 4-inch pipe. The digging is the same, and so of nearly all the labour. The joints cost a trifle more, if lead be used; of course, there is more iron in a foot of 4-inch than in a foot of 3-inch; but, in these days of cheap iron, the whole expense of the former is but a trifle, while the capacity of a 4-inch is nearly double that of a 3-inch. These remarks will apply to the larger sizes, in a general way; that is to say, if there is a likelihood of needing a large pipe in a given street, it is generally better economy to lay it at first than to put down a smaller one, which must be removed ere long.

There have been attempts to improve upon the old-fashioned pipes, but I am not aware that anything is better than plain, old-style shapes, cast vertically, with the socket end down to avoid shot-holes. A good quality of foundry iron should be used, so that the pipe may be tapped with a clean, nice thread, and without too much expense of labour. If the pipe is made of too hard iron it will be hard to tap. Sometimes the pipe will crack in tapping, and it will be difficult to make a clean, sharp thread for the reception of the service-pipe.

There is no need that the street-main should be excessively thick; nor, on the other hand, should it be too thin. For ordinary sizes I think three-eighths inch about the proper thickness. Large sizes should, of course, have a corresponding weight of metal.

Having settled the questions of size, thickness, and quality of his mains, the engineer will next look at the question of their proper location in the street.

The streets of a city having all the modern conveniences will be occupied by gas-mains, water-mains and sewers under ground, and by street railway tracks above ground; and in selecting the proper line for the gas-pipe, it is important to consider its present and possible relationship to each or all the above-mentioned neighbours. It will generally be found that the city authorities will insist that the gas-main shall yield precedence to the sewer, and also to the water-main; if, as is usually the fact, the city owns the water-works. I have often known a gas company to be compelled to take up and remove its mains, at a large expense, in order that a sewer or a water-main might occupy its bed, not always because there was a real necessity for the change, but because the city authorities chose to have it so. If the order to budge comes, it is best to pick up and move, as resistance will be in vain, and irritating to those who should be conciliated.

Now, in a growing town, if the gas engineer happens to be in advance of the city engineer, it is well to remember that the latter will soon be along, and, if possible, anticipate his wishes. He will usually desire to locate his sewer in the centre line of the street, and hence, I think it generally better to lay the gas main pretty near the one kerb line or the other, hoping that the water-main will be laid on the side of the sewer which the gas main does not occupy, and probably this will generally be the result. If the gas-main be placed near the kerb line, it will be easily accessible, under most circumstances. If there be Nicholson or other wood pavement, the objection to disturbing it will be avoided, because the pipe may be reached by removing a small piece of the gutter pavement, which is usually of stone; or if it be of wood, the workmen can get down to the pipe without disturbing it seriously, or doing much damage. This is always important, for obvious reasons. Where the main lies on one side of the street, there is, indeed, a serious difficulty when there is occasion to lay a service to the opposite side, especially in the case of wood pavement, unless, as in a few instances, where the ground is sandy, and the service-pipe can be pushed through under the pavement; but in case of clay or gravel, or of any hard earth, there is no way but to take up the pavement and dig, except one, and that is to double-pipe the street. Sometimes this is the better way, even if the obstacle just mentioned be not in the way. For example, a street is very wide, say 100 feet or wider; long services are liable to trap, and also to other obstructions. In such a case I prefer to lay two pipes, one near each kerbstone. The extra expense is, in part, compensated in avoiding the necessity of laying long service-pipes, if, as in most cases, the gas company furnish the service from the main to the kerbstone, without expense to the consumer. But the great advantage is this—with a short service there is almost always an uninterrupted flow of gas to the customer, and I regard this as of prime importance.

Having decided upon the line, or location, of his pipe, the engineer will next consider the depth at which he should place it. There is one general rule to govern him—viz., the main should be placed below frost, that is, so deep that no ordinary amount of cold will reach it. Every gas manager must be familiar with the evil effect of frost upon gas in a pipe. It depreciates its quality, and interrupts its flow. But there are other evils attendant upon laying a main near the surface. If frost gets below the pipe, it may heave it, and thus disturb the joints. In case frost reaches a main in much force, the contraction caused by it will be injurious to the joints, and it is said that in some cases pipe has been broken by contraction, caused by cold. When laid, the main should never be disturbed by any influence. It should neither expand nor contract, and it should neither be lifted by frost, nor depressed by any force from above.

And this leads naturally to a few words concerning the foundation upon which the pipe should rest. If the ground at the bottom of the trench be solid, that is sufficient; but if it be soft, and liable to either sink or slide, means should be sought to obviate the liability to either. The judgment of the engineer will dictate what should be done in any given case; but he should, by the use of some material—wood, brick, or cement—secure a good bed for his main.

He must look carefully to his grade, and see that, at suitable points, he can secure a complete discharge into drip-boxes of all condensation. The exact circumstances of each case will decide how often, and where, he should place his drips.

Having settled all the foregoing matters, the actual laying of the pipe demands the most untiring supervision. Good joints are of the last importance. Good pipe, good location, good foundation, good grade—all these will not avail unless good joints be secured. Why invest large sums in buildings, retorts, exhausters, condensers, scrubbers, purifiers, and holders, if, after good gas has been made, it is allowed to waste into the ground while on its way to the consumer? I think almost any other error in our business is more excusable than this; and yet, no doubt, this is the point at which a fair profit is wasted annually by many gas companies.

I am not competent to settle the mooted question—which is the better material for joints, cement or lead? My prejudices are in favour of lead. My company have tried both, and now use only lead. Let each decide for himself, but be sure that his joints are tight.

In laying pipe, my method of procedure is this:—

1. I provide the best soft pig lead. I never buy the hard, irregular, uncertain stuff which is sold by the plumbers; because, though nominally cheaper, it is really dearer than good lead; for good joints cannot be made with it every time.

2. I provide a good quality of spun-yarn for gaskets; and to make sure that I have such a quality, I have it manufactured to order.

3. After the main has been placed, the workman drives into the space between the spigot and the socket a gasket of the above-mentioned spun-yarn. This must be thoroughly done.

4. A mould of soft clay is placed about the pipe, near the socket, and melted lead is poured into the mould, so that the space outside of, and next to the spun-yarn, is filled.

Finally. The lead is tamped thoroughly, so as to completely fill the interstice about the spigot.

To make all perfectly sure, the pipe is tested, by letting in the gas, before covering; and, if any leaks are discovered, the remedy is applied at once. Soon after the pipe is brought into use, the line is carefully inspected, and if any signs of imperfect joints are discovered, the pipe is uncovered, at the proper points, and the defect cured.

I have described my own practice, not because I suppose it original, but because it is the best practice I know, and because it has worked well in my experience.

THE CHEMICAL AND METAL TRADES IN 1876.

We make the following extracts from Messrs. J. Berger Spence and Co.'s Retrospect:—

The leading characteristic of last year was the absence of all violent fluctuations, and second to that the fact that the latter months displayed a marked improvement, making the outlook of 1877 brighter than has been the outlook of several years past. Though we are still menaced with the possibility of a war in the East, we ourselves could not view its actual commencement with unmitigated regret. It very often happens that the rumours of war are more disturbing to trade than its actual occurrence. Undesirable as war undoubtedly is from a humanitarian point of view, it nevertheless always creates demands for commodities, stirs up the circulation of money, and creates a vast expenditure; and unquestionably, as was the case directly after the outbreak of the Crimean and Franco-Prussian wars, causes a general revival of trade. Therefore, supposing the Eastern Question again approaches a climax impassable without a recourse to arms, the effect on trade will no doubt be more beneficial than otherwise. We do not wish to be supposed advocates of war merely to bring about some degree of activity in a few branches of trade; but we assert that unless the existing Conference establishes peace on such a firm basis as to render the likelihood of war improbable for some years to come, and relieve men's minds from the turmoil of the past few years in respect to this question, its labours will have been futile, and the inevitable had much better be met at once and summarily disposed of. Capital is abundant, though used with caution, and the rates of interest are extremely low. Credit, no doubt, is limited, but this very limitation will ultimately produce a gradual confidence. Other nations than ourselves have during the course of last year evinced a greater disposition to embrace the principles of Free Trade. The Special Commission to the

French *Conseil Supérieur de Commerce* was sufficiently liberal as to recommend a reduction of many of the imposts and the abolition of others altogether, and doubtless such a recommendation will carry no light weight in the Senate. The accession to power of the Democratic party in the United States is hailed with delight by the upholders of Free Trade principles, and the declaration of its policy is awaited with interest. Russia, it is true, has made a retrograde movement by her threatened protective policy, but we must not expect too much from her in her present state of civilization. These advantages, added to the probability that the days of the lowest prices are past, and to the certainty that trade generally is in a condition of increasing activity, are all circumstances pointing to a more prosperous year than the one just completed. At the same time we would not advise too large expectations. While we have confidence the year just begun will be an improvement on the past one, we do not anticipate a sudden rebound to the prosperity of such a one as 1873, nor would such be desirable for many reasons. The chances are in favour of somewhat better prices and an increased volume of business, and anything beyond this will be unhealthy and forced; but as the year grows old we have no doubt that there will be indications that the country is again preparing to enter on a career of vigorous commercial activity.

Sulphate of Ammonia is one of those articles the exact production of which it is impossible to ascertain. It has been in strong demand all the year, and though it has fluctuated in value at different seasons, its average has been slightly above that of 1875. At no period have stocks been large, certainly not from the want of consumers, though they may have accumulated slightly occasionally through the speculative buying which has been present at various times, but beyond this the supply has at no time been in excess of the demand.

Coal.—Judging from the export statistics, colliery proprietors have had less reason to complain of the adverse influence of dull trade on their particular commodity than they would have it generally supposed. Coal has been in more extensive demand than during any previous year, and the exports have up to the 30th of November exceeded by 1,756,338 tons those of the most active year preceding it. This shows the enormous development of the means of obtaining coal, and unsatisfactory as the prices obtained may have been to owners, they cannot be unremunerative, or there would not be the present expenditure of capital in undertakings which must always be deemed speculations until the mineral is actually reached and the quality proved. The Inspector of Mines has drawn notice to the fact that during 1875 no less than 111 new collieries were in course of sinking in the West Riding of Yorkshire alone. In addition to these there were also 31 in the Leeds district, 17 in Sheffield, 11 in Huddersfield, 6 in Bradford, 14 in Wakefield, 7 in Rotherham, and 12 in Halifax. In many of these ventures the coal has been reached and can now be brought to the surface in quantities varying from 500 to 4000 tons per day, according to the pit. Besides these there are numerous others commenced, of which we have not reliable numbers. The provisions, therefore, for the most accelerated demand which can be anticipated, are ample. At the same time the competition in the future will be keener than in the past, and loud as have been the complaints of low prices during last year, they are not likely to be any the less during the present. The average price obtained for the coal exported last year was 11s. per ton, against 17s. in 1874, and 22s. in 1873. In addition to this, since 1873 colliery proprietors have had restrictions imposed upon them, which slightly increases the cost of obtaining coal. These facts at first sight appear alarmingly disastrous, and seem to justify the outcry against unremunerativeness, but some additional facts will place the matter under a somewhat different aspect. Since 1873 the remuneration paid to the collier has been on a decreasing scale, and that at present paid is variously estimated in different districts at a reduction of from 35 to 75 per cent. If the average be taken as low as 50 per cent. it will explain a great portion of the difference in margin. And to this an increased quantity of 3,500,000 tons in favour of 1876, against 1873, representing additional profit, and the increased output from the new collieries, must be considered. The quantity of coal exported to the 30th of November amounted to 15,144,609 tons.

METALS.

The year 1876 will ever be a memorable one in the annals of iron; not only has the extreme slackness bequeathed by its predecessor been increased, but it has presented phases distinct from other years of stagnation, and developed sources of uneasiness which hitherto have been lightly estimated. Its financial difficulties will give it a prominence distinct from others, and the additional perplexities with which it has surrounded the solution of the future are of themselves matters for serious thought. Vast as have been the losses sustained, they cannot, considering the proportions of the trade, and the peculiar circumstances attached to it, be said to be alarmingly disastrous. Speaking directly of pig iron, makers have been for a long period producing, in many instances, at an absolute loss, and unfortunately had no means of escape. They were placed on a two-horned dilemma, either of which boded disaster. On the one hand, did they resolve to reduce their manufacture, they must have been at once prepared to suffer the serious loss which the blowing out of blast furnaces entails. To adopt such a course would have been almost suicidal, unless the concern were substantially supported financially. It would have meant the disruption of business, the foreclosing of liabilities, possibly grim liquidation. On the other hand, production at a loss could not go on for ever. Whether the production be sold below its cost or be placed in stock, representing idle capital, the resources of the wealthiest concerns have their limit. Thus there were two desperate resources presented, either of which would bring the one inevitable end. Unfortunately, in the hope of a speedy return to remunerativeness, the latter has been the course most generally adopted, but now it cannot be doubted that it would have been infinitely better had many firms—which, by reason of their insufficiency of capital, or inability to realize, have since been compelled to liquidate—boldly submitted to the exigencies of the former in the first instance. Their estates would have realized more satisfactorily for themselves and their creditors, and their action been prolific of good to the trade in general. It must have been apparent to the least foresight that a policy which required, during the days of prosperity, the expenditure of all surplus profits in the rebuilding and enlargement of works, could not possibly constitute a protection against a reaction in trade such as has ensued. The figures given below show that the evil the pig iron trade has had to combat has not been so much a decreased demand, but an unreasonably extended and sustained production, which is alone responsible for the unremunerative prices ruling all the year.

Pig iron exported to—

	Tons.	Value.	Price per Ton.
Nov. 30, 1876	884,741	£2,658,045	£3 0 0
,, 1875	889,402	3,251,461	3 13 0
,, 1873	1,072,262	6,674,999	6 4 0

The branch of iron industry which has suffered most is the finished iron, particularly rails, and it has become to be an anxiously debated question, whether England will ever regain her recent position in respect to this manufacture. Certain it is that the production of rails has decreased to an insignificant tonnage. True, new railroads are now the exception, and extensions are rare; but it is computed on good authority, that 1,200,000 tons of rails per annum are required for renewals alone. Whence is this supplied? England is not making anything approaching the quantity; whereas Cleveland, hitherto the chief centre of this branch, used to turn out her 300,000 tons per annum, she now makes comparatively none, and the same rule will apply to a great extent to other rail-producing districts. The explanation is a simple one. We have by our own enterprise and success engendered a spirit of emulation in the mind of the foreigner, which now that it is aroused it will be found impossible to allay. He has not the same advantages which we possess, in some respects, especially in that of the raw material, but he possesses others which we do not, and—the raw material obtained—he is in a far better position to produce the manufactured article at a less cost than we, and this is what is being done. Countries which a short time ago depended on us for their supplies now purchase our pig iron, manipulate it as they think best, and can afford to undersell us even in our own markets. To attribute the absence of activity in the rail-producing establishments to slackness of trade is not sufficient explanation. There are vast current requirements, a tithe of which we are not asked to quote for, and at the same time there is also the almost equally sustained production of pig iron going on which must be utilized somewhere. There is but one remedy for this which suggests itself, and the sooner it is adopted the better, if the industry is worth saving, and that is to place ourselves on equal terms with our competitors in respect to the cost of manufacture. Much is expected by Cleveland ironmasters from Mr. Lowthian Bell's investigations. The task he has undertaken is one of no small difficulty, and sincerely as we trust his success will be great, we would not build too largely on the highest achievements one man can hope to accomplish for a gigantic interest such as the Cleveland rail-making has been. No doubt if he succeeds in producing an iron rail equal in durability to the steel rail, and at a less cost, no more can be expected, but more than this will be necessary before the industry can be restored to its old importance—there must be the possibility of placing on the continental markets an article in every respect equal to the native, to which no doubt his improvements will be added, and at a less cost than the native, otherwise prejudice will decide against it, and uphold home production. Other descriptions of manufactured iron have been in limited request all the year, and makers have had to submit to consumers prices in a great measure to promote business.

Lead.—The demand for this metal during 1876 was so great that we have made additional calls upon our foreign sources of supply to the extent of about 3000 tons. Our imports to the 30th of November amounted to 75,617 tons, valued at £1,641,625, against 72,568 tons during 1875 to the same time, value £1,639,976. The home consumption has been greater, as there is an increase in the imports and a decrease in the exports. Lead has been entirely free from those violent oscillations of price which have distinguished copper and tin, and at present it is almost at the same level as at the opening of the year. Various causes have at different times influenced its value, but only to a limited extent, for the lowest point it reached was £20 5s. During the latter portion of the year the firmness has been sustained, principally by the smaller supplies offered and the disquieting rumours from the East, and these have also encouraged speculation to some extent.

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

There has been no work done at any of the manufactories here during this week, owing to the Christmas holidays, and at several places next week will also be void. At many establishments, both in the iron and steel trades, the interval is being made use of for the purpose of stock-taking, it being found more convenient to perform that duty now than at Easter time. Under such circumstances very little can be said of business matters which possesses the merit of novelty, the fact being that the transactions of the week have been wholly *nil*. It may, however, be as well to give the nominal quotations for pig iron now current, in order that those who have files of this JOURNAL may compare them with those prevailing a year ago, and in order that they may form an accurate estimate as to the cost of materials in the beginning of the new year. North of England figures are these:—No. 1 foundry, 49s. 6d.; No. 2 foundry, 48s.; No. 3 foundry 46s. 6d.; No. 4 foundry, 45s. 6d.; No. 4 forge, grey, 45s. 6d.; No. 5 forge, mottled, 45s.; No. 6 forge, white, 43s. 6d.; refined metal, 65s.; Kentledge, 50s.; and cinder pig, 40s.; "Acklam" brands, No. 1, 49s.; No. 3, 47s.; No. 4 foundry, 46s.; and forge, 45s.; "Aireside," Leeds, No. 1, 56s.; No. 3, 52s.; No. 4 foundry, 51s.; and forge, 50s.; North Lincolnshire "Redbourn" No. 1, 60s.; No. 2, 56s.; No. 3, 54s.; No. 4 foundry, 54s.; No. 4 forge, 51s.; mottled, 50s.; and white 50s. per ton. Hematite pigs are steady, but as they do not directly affect the price of ironwork, the quotations need not be given at length here.

Pipes are likely to be fully maintained in price henceforth, many of the leading foundry concerns being very fairly supplied with orders for this class of their productions. Ordinary mains are being quoted at about £5 per ton, but if asphalted by the patent process, and cast direct, rather more money is asked.

There is only a moderate sale for any kind of fuel, the opening up of so many new collieries here and elsewhere having had the effect of causing a complete glut of the markets. Both steam and gas coal are plentiful, but vendors are not disposed to give lower quotations except under extreme pressure.

The proposed new railway from Lincoln to Spalding, and thence by the Great Eastern system to London, is looked on with much favour by the South Yorkshire coalowners, and will probably receive their support.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

In both the coal and iron trades of this district there has only been a limited amount of business doing during the past week. The pits, as a rule, were closed on Saturday for the New Year holidays, and but little work will be done during the present week. At the iron-works also operations will be more or less suspended during this week for the holidays and stock-taking.

So far as any business is doing in the coal trade, there is not much change to notice. The mildness of the weather continues to affect the demand for the better classes of round coal, but prices, as a rule, are maintained. In other classes of fuel for manufacturing purposes there is not much doing, owing to the stoppage of many of the works, and common qualities of slack continue a complete drug in the market. The average pit prices in the Wigan district remain about as under:—Best Arley, 11s. to 12s. per ton; Pemberton four-feet, 9s. to 9s. 6d.; common coal, 7s. to 8s.; burgy, 5s. to 5s. 6d.; and slack, 3s. to 4s. per ton; but in the case of large sales, concessions on the above figures might be obtainable.

In the iron trade buyers, as a rule, are holding back until after the holidays, and at the Manchester market on Friday little or no business was done. So far as makers quotations are concerned, they are nominally without change, but pig iron in merchants hands might be bought for a little less money for prompt delivery. Finished iron continues firm, and in some cases rather more money is being asked; but there is no quotable change, Middlesbrough bars delivered into this district being offered at

£6 15s. to £6 17s. 6d. per ton; Lancashire ditto, at £6 17s. 6d.; and Staffordshire at about £7 per ton.

A meeting of the shareholders in the Nantyglo and Blaina Iron-Works Company was held at Manchester on Thursday, Mr. Hugh Mason in the chair, and the annual report which was presented showed a debit in the profit and loss account for the year just ended of upwards of £60,000. This serious item was to a great extent accounted for from three causes—the great depreciation of stock as specially revalued recently by Mr. Radford, C.E.; the present bad state of trade; and the erroneous report a year ago with regard to the stock of small coal on hand. Great economies in the working of the concern, however, were promised, and after some discussion the report was agreed to.

THE COAL AND GENERAL TRADE OF THE NORTH.

(FROM OUR OWN CORRESPONDENT.)

The transactions in the coal trade of the North of England were merely nominal last week. The Christmas holidays and bad weather reduced the shipments to a very limited quantity. Happily for trade, fine weather came in, which enabled large fleets of steamers and sailing ships to leave the Tyne on Thursday and Friday. There will, therefore, be an abundant supply of coals in London this week, and, as the winds have been favourable, it is every way probable that the bye-ports will make up their stocks this week from the arrival of cargoes by sailing vessels.

The freight market is very quiet. Few transactions of any moment were entered upon last week for the coast. In the London trade a few steamers were taken up to replace those detained by the heavy seas. Rather better rates were realized. Mediterranean freights maintain an upward tendency, but there will be no great amount of business entered on until the beginning of January.

Most of the contracts for gas coals have been completed, and with the turn of the year shipments may be expected to be actively resumed at the Tyne Dock. Coasting freights are likely to remain at about the present figure during the remainder of the winter. General trade is quiet. It is not quite so strong as it was a fortnight ago. Through the disturbed state of political affairs in the East, no one can tell what business will be doing at the end of January, and there is little speculation. There is not much to say about the iron trade. It improves but slowly. The chemical business has been a trifle weaker for immediate delivery. But better prices are given for chemicals sold over next year.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

The directors of the Linlithgow Gas Company have intimated a reduction in the price of gas from 5s. 10d. to 5s. per 1000 cubic feet; and the directors of the Coldstream New Gaslight Company have reduced the price of gas from 7s. 6d. to 6s. 8d. per 1000 cubic feet.

A special meeting of the Police Commission of Alloa was held on the 18th ult., to consider the propriety of adopting the Burghs Gas Supply (Scotland) Act, when it was unanimously agreed to adopt the Act, and the clerk (Mr. Buchanan) was requested to take all the legal measures necessary for that purpose.

The Johnstone Police Commissioners have officially notified their adoption of the same Act. Thursday, the 8th day of February, 1877, has been fixed for the next meeting, in keeping with the provisions of the Act. It is not anticipated that there will be any opposition to the unanimous decision of the Police Commissioners.

Mr. J. Falconer King reports that the gas supplied to Edinburgh on the 13th ult., by the Edinburgh Gas Company, had an illuminating power equal to 32·88 candles, while that of the Leith Gas Company stood at 28·73 standard candles. I am not aware of any other place in Scotland having gas of such a high illuminating power as that first referred to, nor am I aware that the burners used in the "Modern Athens" have been adapted so as to consume such gas with economical results.

The average illuminating power of the gas supplied to Glasgow during the week ending the 16th ult., ranged from 25·90 candles to 27·90 candles. In no case did the maximum illuminating power exceed 28·77 candles, while the gas made at the Dawsholm station did not exceed 26·11 candles as its maximum luminosity. The minimum ranged between 25·06 candles and 27·04 candles.

Notwithstanding the high illuminating power of the gas supplied to Greenock, as mentioned in my "Notes" during the last few months, I find, from the proceedings of the last meeting of the Police Board of that town, that grumbling is again showing itself there regarding the quality of the gas supplied to some parts of the town. One member of the commission said he had heard many complaints about the gas, but the Provost remarked that the gas supplied to Greenock was as good as that of any other town in the West of Scotland. Treasurer Blackmore said that he had been supplied with what he thought at first was bad gas; but after getting a larger meter, and having the pipes thoroughly cleaned, the gas was now good. Another commissioner believed that the gas in the lower parts of the town would not be so good as in the higher parts, as gas had a tendency to rise rather than to go down. He suggested that they should get a gasholder for the west end of the town; and Councillor Leith recommended that the public analysts should get a photometer in their office, so that the gas could be tested without the knowledge of the Gas Committee.

The illuminating power of the gas supplied to the city of Perth during the week ending Dec. 16, was—maximum, 26·74 candles; minimum, 24·35 candles; average, 25·55 candles.

For the same week, the average illuminating power of the Dumfries gas was 28·03 candles, the price being 5s. 10d. per 1000 cubic feet. The official statement of that fact in one of the local newspapers also includes the illuminating power and price of the gas in other twelve cities and towns in Scotland; and the most surprising fact in the statement is that 29-candle gas is sold at Galashiels at 3s. 9d. per 1000 cubic feet. Coatbridge, I think, is similarly situated.

The quality of the gas supplied to Busby is still complained of; at all events, it was regarded as a crying scandal so recently as the 27th of December. A correspondent who was then suffering from it writes to say that it is a false economy to trifle with the health of an entire village, and that the rate charged (8s. per 1000 feet) should pay for a good gas. It is enough, at all events, he says, for an ordinary good article, in view of the rates charged in other localities.

At the last monthly meeting of the Forfar Gas Commissioners it was reported that during the preceding eight months there had been a decrease in the amount of the gas made, as compared with the corresponding period of the year 1875, of 771,600 cubic feet, and that the total amount collected for coke and tar was £739 17s. 9d.

It has been resolved to reopen the gas-works at Kinnesswood, Fife, after standing unused for the last two years. The works have been put into thorough repair through the public spirit of Mr. William Heggie, to whom the inhabitants of the village are much indebted during these times of dear paraffin oil.

On Friday last seven shares of the Montrose Gaslight Company were sold by public auction, and, notwithstanding the fall on last year's dividend, there was a keen competition, the shares realizing from £51 10s. to £52.

The Grangemouth Water Commissioners have resolved to borrow the sum of £1200, in addition to the £10,000 already borrowed, for the purpose of completing the new water-works.

It was resolved, at the last meeting of the Glasgow Corporation Water Committee, that the meter system, for detecting and reducing the waste of water, which has been so successfully tested in the Great Western Road district, be in the meantime extended over an area embracing, say, 80,000 people, as and in the manner suggested by Mr. Gale in his report.

A meeting of the Works Committee of the Dundee Water Commission took place last Thursday, when the contractors claims for extra work in connexion with the Lintrathen water supply were under consideration. The special committee appointed in regard to the matter reported that, as the contractors would not agree to meet the commission in conference, as had been suggested, they felt that no other course was open to them but to resist the claims in the court to which the contractors had summoned them. This resolution was approved of by the Works Committee. At the same meeting it was reported by Mr. Watson, the engineer and manager to the commission, that on the 16th of December he had turned on the Lintrathen water into Clatto reservoir. On the 19th a fault occurred in one of the joints of the Lintrathen main, which caused a temporary suspension of the operation.

Under the influence of a strongly-worded communication from the Board of Supervision, the Police Commissioners of Selkirk are about to put their town in order, both as regards water supply and a complete system of drainage.

Dr. Stevenson Macadam, of Edinburgh, has just reported upon the quality of nine samples of water sent to him from Forfar for analysis. His remarks form a powerful condemnation of the conduct pursued by a number of the Forfar town councillors in reference to the question of water supply for that town. He says he has seldom met with a set of waters from a single town which were so grossly impure and unwholesome; and he recommends that immediate steps be taken to close the sources whence they were obtained, and to provide for the introduction of pure and wholesome water.

The authorities of Perth are quite in a muddle on the water question. At a special meeting of the Town Council and Police Commission, on the 18th ult., the proposed water bill of the outside promoters was under consideration; and after a long and somewhat stormy sederunt it was resolved, on the motion of the Lord Provost, to disapprove of the proposal to promote a bill during the ensuing session of Parliament. The committee of the citizens promoting the bill have unanimously resolved that the maximum domestic rate shall be 7d. per £1 of rental (the proposed outside domestic rate being 1s.); that shops, manufactories, &c., shall pay half of the respective domestic rates; that the public rate payable by landlords shall, for the inside, be 1d., and for the outside 2d.; and that arrangements be made for the gradual equalization of the inside and outside rates.

In consequence of the action of the Board of Supervision, the Annan Police Commission recently resolved to send three samples of the water used in the town for analysis to Mr. J. F. King, Edinburgh. That gentleman's report has been received, and it is to the effect that the waters submitted are unfit for dietetic purposes. The result of his analyses, though not altogether unexpected, has rather staggered the inhabitants. The water was polluted with sewage. It has now been resolved by the Police Commission to send twenty further samples from the many sources of water supply, in order to get a more exhaustive report upon the burgh water generally before taking any action in the matter.

Impure water from sewage contamination is getting the credit of a fever epidemic at present prevailing in Newport, and it is seriously proposed to have a main laid from Dundee along the Tay Bridge now rapidly progressing towards completion.

The Glasgow pig iron market closed on Friday for the year 1876. Business was dull and prices were weak, transactions being recorded at 57s. 10d. to 57s. 9d. cash, and at 58s. to 57s. 10½d. one month. The market closed with buyers at 57s. 9d. and 57s. 10d. respectively, and sellers 1½d. more. There was a fall of 7½d. per ton on the week. The year closed 1s. 10½d. above the lowest, 8s. 6d. under the highest, and 9d. under the average price of the year, while the closing quotation was 6s. 9d. under the final quotation of 1875.

There is nothing new to state regarding the coal trade. Prices remain pretty firm, and most of the collieries are kept going tolerably well, but there is no prospect of any immediate improvement in the demand or in the prices.

WATER SUPPLY OF WORSBOROUGH, BLACKER HILL, AND BIRDWELL.—A short time ago a Local Government Board Inspector held an inquiry as to the water supply of these very thickly inhabited colliery villages and townships, and it was then deemed undesirable to obtain a supply from the Barnsley Water-Works. The inspector suggested a separate supply, but this has been found wholly impracticable, and the local board have now determined to construct a reservoir to contain a fourteen days supply from the Barnsley works, and mains will be laid thence to the places to be supplied. A loan of £450,000 will be applied for in the first instance.—*Engineering.*

"HARTLEY MINERAL."—In our "Circular" of March 21, 1876, we stated that a specimen of this remarkable mineral had been submitted to us for inspection, and we referred to some experiments made upon it by Professor Chandler, of Columbia College, and the results of which were given by him in a lecture delivered before the American Gaslight Association. We are happy to learn that a shipment of 400 tons of this "Australian Boghead Coal," as it has been denominated, is now discharging from the *Martin Luther* in the London Docks. This mineral is produced by the New South Wales Shale and Oil Company at their mines at Hartley, 100 miles from Sydney. It is something similar to Scotch Boghead, but its gas-producing power is said to be 25 per cent. greater. The present shipment has been sold to The Gaslight and Coke Company for use as a gas enricher.

WATER SUPPLY OF BRIDGWATER.—A public meeting of the inhabitants of Bridgwater was held at the town hall, on the 18th ult., to consider the intended application to Parliament by the corporation, with respect to the proposed water-works. The Mayor (Mr. Leaker) presided, and moved a resolution to the effect that the council be empowered to apply for a bill to carry out the works suggested by Mr. Hawksley, at an estimated cost of £30,000, the water to be brought from a point known as Ashford Mills, about four miles distant from the town. The meeting was addressed by several members of the corporation, and others in favour of obtaining a supply in order to improve the sanitary condition of the town, and the only objection offered was in the nature of a suggestion that an effort should be made to discover whether a cheaper scheme could not be promoted. The resolution was agreed to with but four dissentients, and although a poll was at first demanded, it was afterwards withdrawn.

PROPOSED PURCHASE OF THE STOKE GAS-WORKS.—At a meeting of the Stoke Town Council, on the 21st ult., Alderman Sweeting moved the appointment of a committee for the purpose of ascertaining the value of

the Stoke Gas-Works with a view to purchasing the same. He reminded the council that, just after the borough was incorporated, the gas-works were offered for sale. But the borough being then very young, did not feel equal to undertaking so important a purchase, and the matter dropped. Since then, Burslem, Longton, and Hanley had begun to move in the purchase of the gas-works in their districts, and he did not see why Stoke should remain behind the other towns of the Potteries. He was convinced that gas-works ought to be in the hands of the corporations, and there was a general movement in the country to bring that state of things about. All that he now asked for was the appointment of a committee, and that step could not do much harm, if it did no good. Mr. Kirkham suggested that the matter should be referred to the Lighting Committee, who were likely to be best acquainted with the subject. Alderman Sweeting signified his acceptance of that proposal. Mr. Nicholls thought it was desirable that the matter should stand over for a time. If they allowed it to do so for six or nine months, they would be in a better position to judge as to what Parliament would sanction, seeing that, in the meantime, several similar applications would be made to Parliament. The motion was carried.

Naphtha Wells.—A few miles from the town of Bakou, in the Caucasus, are situated the naphtha wells of that district. For hundreds of years naphtha has been extracted by the natives from this locality, and the quantity undergronud appears to be unlimited. A well 81 feet deep is shown to the visitor which was dug 200 years ago by the Persians, when they were masters of the country. In summer, when gases are generated in the bowels of the earth, the naphtha is thrown up in jets, some reaching 100 feet in height above the ground, and then runs to waste in the absence of means to collect such large quantities of this oil. Mr. Churchill, the British Consul at Resht, Persia, reports that while at Bakou last year, on his way to his post, he visited the wells on the neighbouring plateau of Balakhana. He says that in 1874 the tax of 25c. per pood (36 lbs.) of petroleum produced, brought the Government 280,000r., showing a produce of 1,120,000 poods of petroleum, and a consumption of three times that amount of naphtha. In that year upwards of 180 manufactories were at work in the outskirts of Bakou, but, owing to the enormous competition of American petroleum, many of the smaller manufactories have been compelled to shut up. The two largest are at Surakh Khana, eight versts from Balakhana. This spot was chosen for economy of fuel, as gas issuing out of the surface is used in lieu of coal or naphtha. You have at Surakh Khana the wonderful sight of green fields and waving corn in the midst of which the removal of a foot or two of earth will reveal a jet of gas that will raise an enormous blaze if set on fire. It is here that the Hindu monastery of fire-worshippers is established, where a tongue of flame is perpetually kept up. But against the advantage of cheap fuel must be set the expense of transport from the naphtha wells. The average price of petroleum at Bakou, is stated by the consul at 1r. 10c. per pood, and the cost of transport to Moscow at 57c. There is great room for economy in the transport of the raw material to the manufactories, which might be effected, as in America, by constructing a railway with suitable tanks, or by means of gravitation through an iron pipe; and some saving might also be obtained in the process of purifying the petroleum. It is only by such means that the Bakou petroleum can compete with that of the United States. The naphtha makes a very good substitute for coal in steamers employed in the Caspian Sea.—*The Times.*

Crystal Palace District Gas Company.—In accordance with their usual liberality, the directors of the Crystal Palace District Gas Company arranged for the annual distribution of Christmas gifts of meat to their *employés* on Saturday, the 23rd ult. Prime joints of beef, legs and shoulders of mutton, turkeys, &c., numbering together about 300, were laid out upon benches in the large meter-room at the gas-works, Bell Green, Lower Sydenham, which, for the time, appeared to have been turned into a meat market. It was a very interesting sight, and must have been exceedingly gratifying to the directors and secretary, whose kind thoughtfulness had determined that each of their servants should at least have the wherewithal for a good dinner on Christmas Day. The men being assembled, Magnus Ohren, Esq., the secretary, addressed a few suitable words to them. He referred to the interest the directors of the company took in their workmen, which was evidenced, he said, by the display of generosity before them, and the provision they had made that each man should carry away with him that afternoon a Christmas joint. The joints varied in size from five to about sixteen pounds, and the men who had served the directors longest would receive the largest pieces of meat. It had always been a great pleasure to him, during the 21 years he had been connected with the company, to assist at annual distributions similar to that they were then engaged in, and he could assure the men that they would lose nothing by doing their duty. He would strongly urge them to be diligent in their work and to keep sober. He regretted very much that their old friend, Mr. Watson, was not present with them that afternoon. Mr. Watson had felt it his duty, on account of ill health, to resign his post of engineer to the company, which they would all, no doubt, regret to hear. Mr. Charles Gandon had been appointed engineer in his stead, and he had the pleasure of introducing that gentleman to them. Mr. Gandon, in addressing the men, said he hoped he should gain their respect and esteem as much as Mr. Watson had done, and that they would all work together as pleasantly in the future as in the past. He wished them each one long life and prosperity. Hearty cheers were given for Mr. Ohren and Mr. Gandon, and then the company broke up, each man bearing away a fine joint of meat to gladden his Christmas meal.—*Sydenham Gazette.*

Register of New Patents.

202.—Newton, A. V., Chancery Lane, London, "*Improvements in liquid-meters.*" A communication. Provisional protection only obtained. Dated Jan. 18, 1876.

This invention relates to that description of liquid-meters in which the flow of the liquid is measured by pistons working in cylinders, and operated by a head or pressure, which forces or causes the liquid to be delivered through pipes or otherwise, as required.

It consists in a double cylinder meter, in which each cylinder is furnished with a reciprocating and elongated or double-headed piston, and an intermediate cylindrical valve operated by the piston to control passages arranged for the purpose of effecting the reversal of the pistons, which latter and their valves move successively in like directions. The valves are what may be termed floating balanced ones, and the meter is constructed so that there is a free continuous outlet through the valves from the two cylinders, and a constant pressure of the liquid between the two heads of each piston, and furthermore so that the liquid under pressure is admitted alternately to the four ends of the cylinders outside of the piston heads by means of the intermediate valves which move back and forth with the pistons, causing the contained liquid to be forced out of the opposite ends of the cylinders. The inlet-pipe is situated a little to one side of the longitudinal centre of the one cylinder, and the outlet-pipe to the opposite side of the longitudinal centre of the other cylinder; and in a line with each of these pipes is a passage connecting the two together. These passages are for admitting liquid from one cylinder to the other, and they are alternately covered by the cylindrical floating valves, which have an annular recess in their outer peripheries, forming passages for the flow of the liquid, and are driven alternately to the right or left by the pressure of their respective piston-heads against pins which project from their opposite edges. On the top of the two cylinders are two cross watercourses or passages, which extend from the middle of one cylinder to the end of the other; and the like arrangement, but the inverse of this is provided at the bottom of the cylinders. These cross watercourses or passages open at one end into their respective cylinders, at points within the control of the floating valves, and at their other end their ports are near the heads of the cylinders. By this arrangement the liquid supplied under pressure to the meter will fill the space between the cylinder-heads, impart a to-and-fro motion to the pistons, and operate the valves so as to allow of a continuous discharge of the liquid.

By providing an indicator, which may be operated by the pressure of one of the piston-heads against a lever, the amount of liquid passed through the meter will be ascertained.

246.—Moore, J., Wolverhampton, "*An improved apparatus to be employed in relieving the pressure in gas-retorts.*" Patent dated Jan. 21, 1876.

According to this improvement, one side of that part of the dip-pipe which is within the hydraulic main, or as much thereof as required, is formed flat. This is faced on the outside, and a faced valve is made to slide vertically thereon, and is carried in V's or other suitable guides cast to the dip-pipe, or otherwise conveniently fixed thereto, so as to keep the valve up to its face. The valve slides over an opening or port formed in the flat part of the dip-pipe, and above the level of the water in the hydraulic main, but preferably at such a height as to allow of the valve being pulled up over the flat part between the opening and the flange which fixes the dip-pipe to the lid of the hydraulic main. A valve-spindle, which is connected at its lower end to the valve, passes up through a stuffing-box preferably cast upon or formed in the flange of the dip-pipe, which connects the dip-pipe with the lid of the hydraulic main. The top of the valve-spindle is connected to a lever so arranged with a weight at one end, and with a vertical rod or chain passing down in front of the retort-bed at the other, that the weight acts to close the valve by pushing it down, and the valve is opened by pulling down the rod or chain, and thus raising the valve, though, of course, the weight may be arranged to open and the rod or chain to close the valve. A stop is provided to prevent the valve descending below the proper point, and a suitable catch or hook is provided to retain the lower end of the rod or chain when the valve is required to be open.

When the valve is raised the port is opened, and the gas can pass freely from the retort-direct into the hydraulic main without passing through the water in the main. When the valve is lowered the port is closed, and the gas from the retort must pass through the water in the usual way; or in the case of charging the retort the dip-pipe (which is sealed in the usual way) prevents any return of the gas when the valve is closed.

249.—Vaughan, E. P. H., Chancery Lane, London. "*An improved fire alarm and gas intercepter.*" A communication. Patent dated Jan. 21, 1876.

This invention of an apparatus for signalling the outbreak of fires, and at the same time (when so required) cutting off the gas from the burning premises, is not described apart from the drawings which accompany the specification.

261.—Palmer, J. D., Camberwell, Surrey, "*Improvements in the construction and arrangement of burners used for illuminating purposes in which gas is employed as the illuminating medium for diffusing light.*" Provisional protection only obtained. Dated Jan. 22, 1876.

Instead of making gas-burners as heretofore practised, it is proposed, according to this invention, to construct them in the following manner:—A ring or band of metal, or other suitable material, is formed with a vertical annular groove or channel therein. Into this groove there is fixed and hermetically sealed or enclosed the lower edge and part of an oval or elliptical-shaped dome or cap of very finely woven wire gauze made of platinum, iridium, or other metal possessing the like properties of resisting great heat and non-oxidizable. To the upper part of this wire gauze there is affixed air-tight a rod of metal or other suitable material, the lower end being fastened to a cross-bar fixed by its ends to the ring or band which supports the wire gauze cap.

To one part of the under edge of the ring or band one end of a short bent pipe or tube of metal is fixed, and the other end is connected by a screw to the pipe through which the gas passes, similarly to the ordinary Argand burner of a gas-lamp. Opposite to the bent pipe another short bent pipe is affixed to the lower edge of the annular grooved band. This last-mentioned pipe is either formed open at its lower end, or with holes in its side, or both at the end and side, for the passage of atmospheric air, which is intended to mix with gas in the wire gauze cap. The gas and air pass through holes in the band, and that part of the groove therein which is not occupied by the wire gauze, or the gas and air may be otherwise allowed to pass into the space within the cap.

The operation of the burner is as follows:—Upon gas being admitted inside the wire gauze cap it will mix with the air therein, and, upon a flame being applied to the outside of the cap, the gas will become ignited, and flame for a short time, after which the flame will disappear and be followed by an intense white luminous body covering the entire outer surface of the wire gauze cap, and thus emit a brilliant white light produced by the perfect combustion of the gas resulting from the combination of the air with the gas, and its passage through the meshes or interstices of the heated wire gauze of which the cap is made.

262.—Lake, W. R., Southampton Buildings, London, "*Improvements in the manufacture of gas and in the utilization of the same for illuminating, heating, and ventilating purposes, and in apparatus therefor.*" A communication. Provisional protection only obtained. Dated Jan. 22, 1876.

The nature of this invention consists in improvements in the method of manufacturing hydrogen gas, in the combination of hydrogen gas, superheated steam, and petroleum and its distillates, and other solid and liquid hydrocarbons, and in the means employed in manufacturing and in using the same.

APPLICATIONS FOR LETTERS PATENT.

4909.—Harris, H. G., Westminster, London, "Improvements in steam-pumps." Dec. 19, 1876.

4916.—Dugard, W. H., Birmingham, "Improvements in fans for blowing, which improvements are also applicable to fans for exhausting, and to centrifugal pumps." Dec. 20, 1876.

4917.—Gill, J., Bridgnorth, Salop, "A new or improved gas-stove." Dec. 20, 1876.

4935.—Jennings, G., Lambeth, London, "Improvements in water-closets and latrines, and in valves for regulating the supply and discharge of water and preventing percussion in water-pipes." Dec. 21, 1876.

4943.—Waterson, H., Birmingham, "Improvements in ratchet-braces." Dec. 21, 1876.
4967.—Storer, J., and Pugh, C. H., Stafford, "Improvements in retort-lid fastenings." Dec. 23, 1876.
4987.—Hallewell, R., Blackburn, Lancs, "Improvements in gas motor-engines." Dec. 23, 1876.
4988.—Hallewell, R., Blackburn, Lancs, "Improvements in gas and water motor-engines, and in gas motor-engines." Dec. 23, 1876.
5006.—Heck, J. H., Perry's Close, London, "Improvements in direct-acting steam-pumps." Dec. 27, 1876.
5013.—Kennedy, T., Kilmarnock, N.B., "Improvements in water-meters." Dec. 28, 1876.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

3095.—Slater, J. W., Tamworth Terrace, London, "Improvements in deodorizing and purifying sewage." Aug. 2, 1876.
3620.—Boulton, M. P. W., Oxfordshire, "Improvements in engines worked by the combustion and expansive force of an inflammable fluid mixture." Sept. 15, 1876.
4380.—O'Neill, A., Baltimore, U.S.A., "Improvements in pipe-joints." Nov. 11, 1876.
4386.—Clark, A. M., Chancery Lane, London, "Improved apparatus and machinery for generating and utilizing a motive gas obtained from water." A communication. Nov. 11, 1876.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

3781.—White, W., "Improvements in the precipitation of sewage and other foul waters, and in the preparation of precipitating materials." Nov. 20, 1873.
3822.—Hawkins, J. G., "Improvements in the apparatus used in the manufacture of gas." Nov. 22, 1873.
3848.—Lake, W. R., "Improvements in gas-engines, and in apparatus for producing gaseous mixtures to be used in the same." Nov. 25, 1873.
3857.—Goldsmith, G., and Dilkes, J., "Improvements in self-acting gates or sluices for preventing the overflow of water from rivers or watercourses." Nov. 26, 1873.
3902.—Morton, R., "Improvements in refrigerators or apparatus for cooling liquids, parts of which improvements are also applicable to distillation, surface condensation, heating or cooling fluids, air, or gases." Nov. 29, 1873.
3953.—Paget, F. A., "Improvements in the mode of and apparatus for softening and purifying water." Dec. 2, 1873.
4001.—Messenger, T. G., "Improvements in pipe-joints, and in the couplings thereof." Dec. 5, 1873.
4038.—Cockey, H., and F. C., "Improvements in gas-stoves." Dec. 8, 1873.
4130.—Phillips, J., "Improvements in pipe-joints." Dec. 16, 1873.
4160.—Forbes, The Rev. G. H., "Improvements in the manufacture of gas and quick-lime." Dec. 18, 1873.
4172.—Akester, J. C., "An improved silica gas-stove." Dec. 19, 1873.
4192.—Strode, W. W., Mackenzie, J., and Williams, E. P., "Improvements in gas-stoves, to be named the 'Cambridge gas-stove.'" Dec. 20, 1873.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

3224.—Kirk, A. C., "Improvements in or connected with retorts." Nov. 9, 1869.
2499.—Wilson, J. C., "An improved revolving engine and pump, applicable as a fluid-meter." Dec. 3, 1869.
3522.—Prideaux, T., "Improvements in purifying and calcining gas and soap limes and other chemical refuse of lime which has been used in the manufacture of such articles." Dec. 6, 1869.
3581.—Croll, A. A., "Improvements in the treatment of ammoniacal liquor of gas-works to obtain therefrom salts of ammonia." Dec. 11, 1869.
3682.—Livesey, G. T., "Improvements in apparatus used in the manufacl ture of gas." Dec. 20, 1869.

Share List of Metropolitan Gas and Water Companies.

(Corrected by Mr. F. N. Golding, Sun Court, Cornhill, from the latest Stock Exchange Quotations.)

Number of Shares issued.	Amount per Share.	Name.	Amount paid up per Share.	Last Divd. p.Cent. p. Ann.	Latest Quotations.	Number of Shares issued.	Amount per Share.	Name.	Amount paid up per Share.	Last Divd. p.Cent. p. Ann.	Latest Quotations.	Number of Shares issued.	Amount per Share.	Name.	Amount paid up per Share.	Last Divd. p.Cent. p. Ann.	Latest Quotations.
	£	Gas Companies.	£ s. d	£ s. d	£		£	Gas Companies.	£ s. d	£ s. d	£		£	Gas Companies.	£ s. d	£ s. d	£
10000	20	Anglo-Romano . .	20 0 0	9 0 0	16—18	5800	10	Hong Kong (Lim.)	10 8 0	10 0 0	15—16	9000	4	Unit. Gen'l., Limrck.	4 0 0	2 10 0	2½—3½
5000	20	Bahia (Limited). .	20 0 0	2 0 0	15—13	56000	50	*Imprl. Continental*	43 15 0	9 10 0	88—90	1500	10	*Wandsw. & Putney*	10 0 0	10 0 0	19—20
1000	20	Do., do., redeem.	20 0 0	2 0 0	25—27	378350*l.*	Sk.	*London*	100 0 0	10 0 0	214—217	1500	10	Do.	10 0 0	7 10 0	11—12
1500	20	Do., 2nd pref. .	20 0 0	7 10 0	19—21	150000*l.*	Sk.	Do., 1st pref. . .	100 0 0	6 0 0	140—145	2957	10	Do.	10 0 0	7 0 0	..
40000	5	Bombay (Limited).	5 0 0	7 10 0	7¼—7⅝	14450	Sk.	Do., 2nd pref. . .	100 0 0	6 0 0	..	993	10	Do.	3 0 0	7 0 0	..
10000	5	Do., fourth issue.	4 0 0	7 0 0	5—5⅛	4350	Sk.	Do., 3rd pref. . .	100 0 0	6 0 0	..	16000	5	*West Ham*	5 0 0	10 0 0	8—8½
10000	20	British (Limited) .	20 0 0	10 0 0	40—42	7622	25	Do., A shares . .	12 10 0	6 0 0	33—34	10000	5	Do., new shares .	2 10 0	10 0 0	3—4
7500	20	Cagliari (Limited).	20 0 0	5 0 0	..	268051.	All	Do., Debent. stk.	100 0 0	5*l.* & 6*l.*	8–10pm.						
5500000*l.*	Sk.	*Commercial*	100 0 0	10 0 0	213—215	15000	5	Malta and Mediterranean (Limited).	5 0 0	2 0 0	2⅞—3⅛						
70000	100	Do., 7 per cent. .	..	..	..			Do., preference .	5 0 0	7 10 0	4½—5⅛						
20000	20	Continental Union.	20 0 0	6 0 0	22½—23½	6000	5	Mauritius (Limited)	2 0 0	..	1—2						
10000	20	Do., new	12 10 0	6 0 0	2-2¼pm	20000	5	Monte Video (Lim.)	20 0 0	8 0 0	19—20						
10000	20	Do., preference .	20 0 0	7 0 0	26—28	25000	20	Nictheroy, Brazil (Limited)	10 0 0	3 10 0	6—8	12000	100	Water Companies. Chelsea	100 0 0	6 0 0	145-9 xd
75000	Sk.	*Crystal Palace District*	100 0 0	10 0 0	214—217	8000	10	Oriental (Calcutta).	5 0 0	9 10 0	8¼—8⅝	1800000	100	East London . . .	100 0 0	6 0 0	146-9 xd
125000	Sk.	Do., 7 per cent. .	100 0 0	7 0 0	150—155	30000	5	Do., new shares .	3 0 0	9 10 0	2-2⅛pm.	8000	50	Grand Junction . .	50 0 0	5 0 0	73—75
50000	Sk.	Do., preference .	100 0 0	6 0 0	135—140	30000	5	Do., new shares .	3 0 0	9 10 0	2-2⅛pm.	8000	50	Grand Junction . .	50 0 0	5 0 0	73—75
22406	10	European (Limited)	10 0 0	10 0 0	18½—19½	10000	5	Ottoman (Limited).	5 0 0	3 0 0	2½—3	5840	25	Do., ¼ shares . .	25 0 0	5 0 0	26½—27½
12000	10	Do., new shares.	7 10 0	10 0 0	7—8pm.	17500	10	Parà (Limited) . .	10 0 0	7 0 0	4—5	2160	25	Do., new ditto; max. div., 7½ p.c.	25 0 0	5 0 0	34—36
35406	10	Do., new shares .	5 0 0	10 0 0	5—6pm.	27000	20	*Phœniz*	20 0 0	10 0 0	42—44						
3797770*l.*	Sk.	*Gaslight & Coke* A.	100 0 0	10 0 0	215—218	3600000*l.*	100	Do., new	60 0 0	7 10 0	95—100	547960	100	Kent	100 0 0	8 0 0	173—178
1000000*l.*	Sk.	Do. B.	100 0 0	4 0 0	86—90	1440000*l.*	Sk.	Do., capitalized .	100 0 0	5 0 0	100—105	970	100	Lambeth	100 0 0	6 5 0	146-9 xd
30000	10	Do. 5 per ct. pref. conv., 3rd issue.	all	5 0 0	20½—21	36000	20	Do., new, 1876. .	..	..	14-16pm	1161	100	Do.	100 0 0	6 5 0	143-6 xd
50000	10	Do. do., 4th do. .	6 0 0	5 0 0	8-8¼pm.	7359	5	Rio de Janeiro (L.)	20 0 0	10 0 0	32—34	442	100	New River	100 0 0	7 0 0	185—195
50000	10	Do. do., 5th do. .	2 0 0	5 0 0	7⅞–8pm.	2000	5	Singapore (Limited)	5 0 0	7 10 0	5½—5⅝	4475	100	Do.	60 0 0	7 0 0	50–55pm
2000000*l.*	Sk.	Do. C 10 p.c. pref.	100 0 0	10 0 0	230—240	1500	32½	Do., preference .	5 0 0	7 10 0	5½—6¼	400000	100	Do., deb. sk., 4 p.c.	100 0 0	4 0 0	101—103
3000000*l.*	,,	Do. D do. do. .	100 0 0	10 0 0	230—240	4000	50	Shanghai	32 10 0	12 0 0	30—32	3036	100	Southwrk. & Vauxh.	100 0 0	4 0 0	111—114
1650000*l.*	,,	Do. E do. do. .	100 0 0	10 0 0	230—240	4000	12½	*South Metropolitan*	50 0 0	10 0 0	108—110	1296	100	Do., pref. stock .	100 0 0	5 0 0	112—114
300000*l.*	,,	Do. F 5 do. do. .	100 0 0	5 0 0	114—116	20000	12½	Do.	12 10 0	10 0 0	27—28	..	100	Do., D shares . .	100 0 0	4 0 0	108—111
600000*l.*	,,	Do. G 7½ do. do. .	100 0 0	7 10 0	165—170			Do., new shares .	9 0 0	10 0 0	12½—13½	..	..	Do., 4½ preference	100 0 0	4 10 0	106—108
13000000*l.*	,,	Do. H	100 0 0	7 0 0	150—153	15000	10	*Surrey Consumers.*	10 0 0	10 0 0	21—22	1600	100	Do., new ord. No. 1	40 0 0	4 10 0	106—108
6200	5	Georgetown, Guiana	5 0 0	5 0 0	..	10000	10	Do., new	8 0 0	10 0 0	9½–10½p.	12172	61	West Middlesex . .	61 0 0	6*l.* p.sh.	133—135

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,

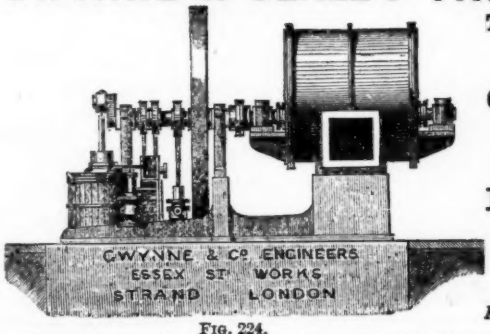


FIG. 224.

The BEST EXHAUSTERS IN THE WORLD.

GWYNNE & CO.
HAVE MADE THE
LARGEST AND MOST PERFECT
EXHAUSTING MACHINERY
Ever produced, and the most economical in working.

Prices and every information on application.

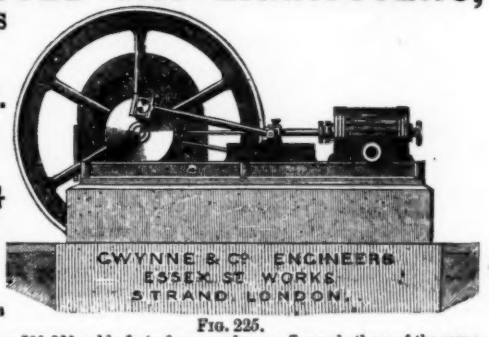


FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND CO. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters at 1 dalterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES,
CAN BE HAD ON APPLICATION TO
GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.
G. & Co. are now manufacturing for a London Gas Company three of their 210,000 *cubic feet Patent Gas Exhausters, and many of all sizes.*

WANTED, Spent Oxide. The Sheffield Chemical Company, Attercliffe, are prepared to PURCHASE large or small quantities.
Address, with particulars, the Proprietors, HORNBY, FAIRBURN, AND CO.

WANTED, a steady Man, of good character, as STOKER in a country Gas-Work. Average wages 26s. per week.
Applications, with references, to be made to Mr. HARVEY, Gas-Works, Winsford, CHESHIRE.

WANTED, a situation as Working MANAGER in a small Gas-Work, or Leading Man in a large Work. Thoroughly understands the manufacture of gas in all its branches. Can take meters, do all main and service laying, and general repairs.
Address FRANK SCOTT, Beaufort Gas-Works, SOUTH WALES.

WANTED, by a Working Manager of a Gas-Work, a SITUATION. Can do main and service laying, meter-fixing, setting of retorts, clay or iron, inside or outside fittings of any description. Twelve years testimonials. Abroad preferred.
Address No. 332, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO DRY GAS-METER MANUFACTURERS.

WANTED, a situation as Metal Caster, by the Advertiser, who has had 18 years experience in Thomas Glover and Co.'s system. Is acquainted with the various metals used in the manufacture of Gas-Meters.
Address No. 340, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by the Shrewsbury Gas Company, a first-class Man as FOREMAN, who thoroughly understands the manufacture of gas and the machinery in connexion therewith. Wages 35s. per week. House, coal, and gas. Preference given to a married man with no family.
Applications, in own handwriting, stating age and qualifications, accompanied by recent testimonials and fitness for managing men, to be sent to me on or before the 11th of January next.
None but those whose character will bear the strictest investigation need apply.
By order of the Directors,
S. B. DARWIN, Secretary.
Gas-Works, Dec. 28, 1876.

ADVANTAGES OF GAS FOR

COOKING AND HEATING.

HINTS ON GAS BURNERS, &c.

By MAGNUS OHREN, A.I.C.E., F.C.S.

Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works, Lower Sydenham, London, S.E.

CONDENSERS FOR SALE.

THE Tillicoultry and Devonside Gas Company have for immediate SALE, as they stand—
One set of Atmospherical Vertical Condensers, 18 pipes, 11 ft. 3 in. high by 7 in. diameter, with tar-boxes, &c., complete.
Also a Battery Condenser, 13 ft. by 8 ft. by 2 ft., with boxes, &c., as above.
Apply to Mr. FRANK SCOTT, Gas Manager, TILLICOULTRY.

BOILERS.

FOR SALE, Cheap, Two 5-h.p. Cornish BOILERS, in good condition. May be seen at the Reading Gas-Works.
Particulars can be obtained of Mr. E. BAKER, Engineer.

FOR SALE—A second-hand Gasholder, in good condition, 33 ft. diameter and 9 ft. deep. Has been in use about nine years. Also some 5-in. and 4-in. Donkin Valves. To be sold at a moderate price.
Apply to Mr. W. T. HEWS, Gas-Works, HENLEY-ON-THAMES.

FOR SALE—A 10 ft. Gasholder (second- hand), with metal tank, columns, pulleys, and weights, now erected and in working order. Suitable for a small factory or private residence.
Apply at LINTZFORD MILL, Lintz Green, near NEWCASTLE-UPON-TYNE.

THE Blackburn Gaslight and Coke Com- pany have FOR SALE one 25,000 feet per hour EXHAUSTER and ENGINE combined, with one 10-h.p. Boiler. The Exhauster is by Musgrave and Co., of Bolton, and is only to be sold as it has been replaced by a larger one.
Application to be made for price, &c., to the undersigned.
S. R. OGDEN, Engineer.

GOVERNORS FOR SALE.

FOR SALE, at the Eccles Street Works of the Liverpool United Gaslight Company, two GOVERNORS, each having a 10-in. cone and 16-in. bye-pass.
Also four GOVERNORS, each having a 6-in. cone and 8-in. bye-pass. These Governors are in excellent order, and are fitted complete and ready for work, and have been replaced by apparatus of larger dimensions.
Apply to Mr. KING, Engineer, Gas Office, Duke Street, LIVERPOOL.

TAR AND AMMONIA WATER.

TO BE DISPOSED OF, the Tar and AMMONIA WATER produced at the Merthyr Tydfil Gas-Works.
The Directors of the Company will be glad to receive offers to purchase the same for a period of Three or Five years.
Particulars as to quantity, &c., may be obtained of the undersigned.
The right to accept or refuse the highest or any offer is reserved.
By order,
JOHN LEES COCKER, Secretary and Manager.
Gas Office, Merthyr Tydfil, Glamorganshire,
Dec. 13, 1876.

TO BE SOLD.

THE Keighley Local Board of Health have FOR SALE, by private contract, the GAS-WORKS PLANT and APPARATUS at present in use at the Low Bridge Works, in Keighley, comprising 165 Mouthpieces, Hydraulics, two 12-in. Vertical Condensers, Engine and Exhauster, Tar and Liquor Pumps, with shafting, &c., wrought-iron Scrubber, Station-Meter (Braddock's), and other apparatus, with the valves and connexions complete (12-in. diameter throughout).
The whole are in good condition, and can be seen at work, on application to the undersigned, at the Offices, Low Bridge Works, Keighley, from whom any further particulars can be obtained.
By order,
JOHN LAYCOCK.
Keighley, Dec. 21, 1876.

THE Swansea Gaslight Company have for immediate SALE, the following Plant:—
A 6-h.p. Patent Trunk Engine. (Beale.)
Exhauster to pass 15,000 feet per hour. (Beale.)
An 8-h.p. Grasshopper Engine. (Easton and Amos.)
Exhauster, 20,000 ft. per hour. (Beale.)
Tar, Liquor, and Water Pumps, Eccentrics, Shafting, and Driving Pulleys.
Wrought-iron Condenser, six vertical Legs, 30 ft. high, 24 in. by 6 in., with tar-boxes, dips, and syphons.
Wrought-iron Scrubber, 5 ft. diameter, 20 ft. high.
A set of four cast-iron Purifiers, 12 ft. square by 5 ft. deep, with galvanized wrought-iron covers, lifting apparatus, four tiers of wooden sieves, 10-in. connexions and valves.
May be seen at the Gas-Works, Swansea. The whole in perfect working order; replaced by plant of larger dimensions.
Further particulars may be obtained on application to Mr. THORNTON ANDREWS, SWANSEA.

RETORTS, FIRE-BRICKS, AND IRON RETORT FITTINGS.

THE Gas Committee of the Wigan Cor- poration are prepared to receive TENDERS for the supply of 140 lengths of Fire-Clay through RETORTS, and the necessary Fire-Bricks and Fire-Clay for the same.
TENDERS are also invited for the supply of the necessary IRONWORK for the above.
Plans, specifications, and other particulars may be obtained on application to Mr. J. G. Hawkins, the Manager of the Gas-Works, WIGAN.
Sealed tenders, endorsed "Tender for Retorts, &c.," to be sent in to Mr. HAWKINS, on or before the 17th of January, 1877.
The lowest tender not necessarily accepted.
Dec. 9, 1876.

TO RETORT MAKERS.

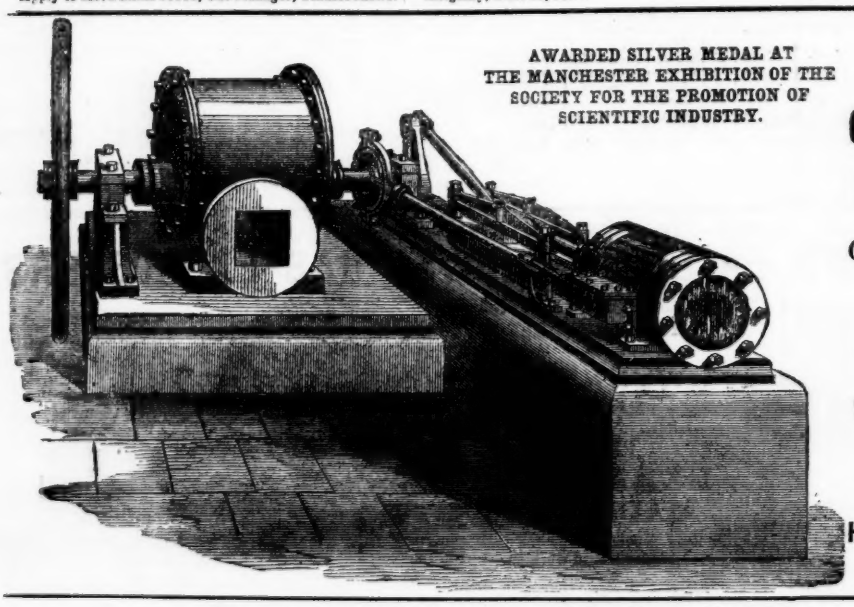
THE Gas Committee of the Bury Cor- poration are prepared to receive TENDERS for the supply of 88 D Fire-Clay Through RETORTS, 18 in. by 14 in. by 10 ft. long; and 23 D Fire-Clay Through RETORTS, 16 in. by 14 in. by 9 ft. 9 in. long, delivered free at the Railway Station, Bury. The whole to be delivered on or before the 30th of June next.
Sealed tenders, addressed to the Chairman of the Gas Committee," and endorsed "Tender for Retorts," to be sent in on or before the 12th day of January, 1877.
The Committee do not bind themselves to accept the lowest or any tender.
Bury, Lancashire, Dec. 23, 1876.

MARPLE GAS-WORKS.

TO GASHOLDER MAKERS AND OTHERS.

CONTRACT NO. 2.

THE Directors of the Marple Gas Com- pany, Limited, are prepared to receive TENDERS for the supplying, fixing, and completion of a Single-Lift GASHOLDER, 60 ft. diameter and 20 ft. 6 in. deep, with all necessary guides, wheels, columns, and girders complete, to be erected at their Gas-Works, Marple Bridge.
The drawings and specifications may be seen on application at the works.
Sealed tenders to be sent in on or before Saturday, the 13th day of January, 1877, addressed to the Chairman of the Gas Company, and endorsed "Tender for Gasholder."
The Gas Company do not bind themselves to accept the lowest or any tender.
Further particulars may be obtained upon application at the works, or to Mr. JAS. JACQUES, Gas-Works, STOCKPORT.
Dec. 30, 1876.



AWARDED SILVER MEDAL AT THE MANCHESTER EXHIBITION OF THE SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY.

BEALE'S
Improved Patent
GAS-EXHAUSTERS
WITH
ENGINES COMBINED.
Sole Makers,
GEORGE WALLER & CO.

Makers of
ENGINES, EXHAUSTERS,
INDEX and DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, and other PUMPS,
SCRUBBERS and PURIFIERS,
CONDENSERS, BOILERS, &c.

PHŒNIX ENGINEERING WORKS,
HOLLAND STREET, S.E.,
AND
STROUD, GLOUCESTERSHIRE.

D. BRUCE PEEBLES & CO.,
ENGINEERS,
FOUNTAINBRIDGE WORKS, EDINBURGH,
MANUFACTURERS OF **WET AND DRY GAS-METERS;**
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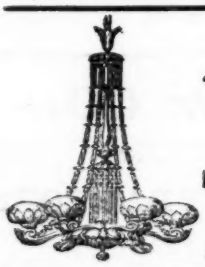

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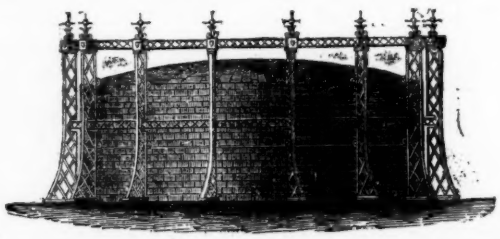

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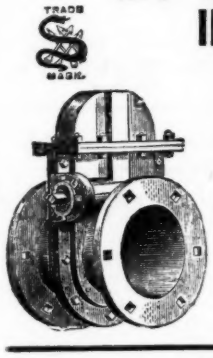

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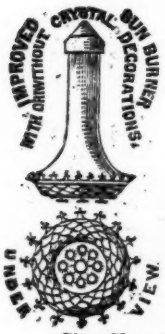

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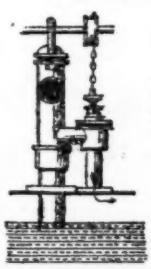

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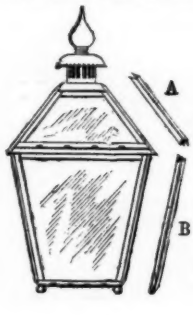

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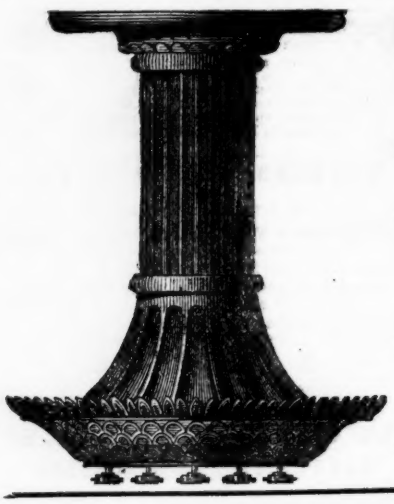

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These positive advantages, thus briefly enumerated, do not fairly place the great advantages of this Meter before the purchaser, therefore justice cannot thus be rendered to the Meter. The great advantages can only be seen when this Meter is placed in comparison with those constructed upon other principles, which we will now briefly do:—*First*, with the Common Wet Meter; *second*, with the Compensating Wet Meter; *third*, with the Dry Meter (so called).

First, then, the COMMON *Wet* Meter varies in measurement with every variation of the water-line to the extent of 5 per cent. (2 per cent. against the consumer, and 3 per cent. against the Company, as per Sales of Gas Act). This being the least necessary amount for the practical working of the float; but it is not sufficient to ensure efficiency of action under the varying demands of gas supply; hence the many arrangements for protecting the float from the action of the gas. The WARNER & COWAN Meter is unaffected by change of water-line in its measurement, therefore has a longer range of float, hence is less sensitive and more stable in action. The larger sizes are made with floats too, which the Common Wet Meter cannot have (and so are exempt by Act of Parliament). Thus the Companies are entirely dependent upon their inspectors for the due measurement of the gas by these very important instruments, the large Meters.

The COMPENSATING *Meter* has the same form of measure (the common wheel) as the ordinary Wet Meter, but the makers, knowing the defects of it, have endeavoured to remedy them by the assistance of various contrivances to maintain a constant water-line. Messrs. WARNER & COWAN have dealt with the measure itself; the wheel is altered in construction to make it an unvarying measure, but in action the Meter is as simple as the most simple of Common Wet Meters, and can be repaired as easily as one of them.

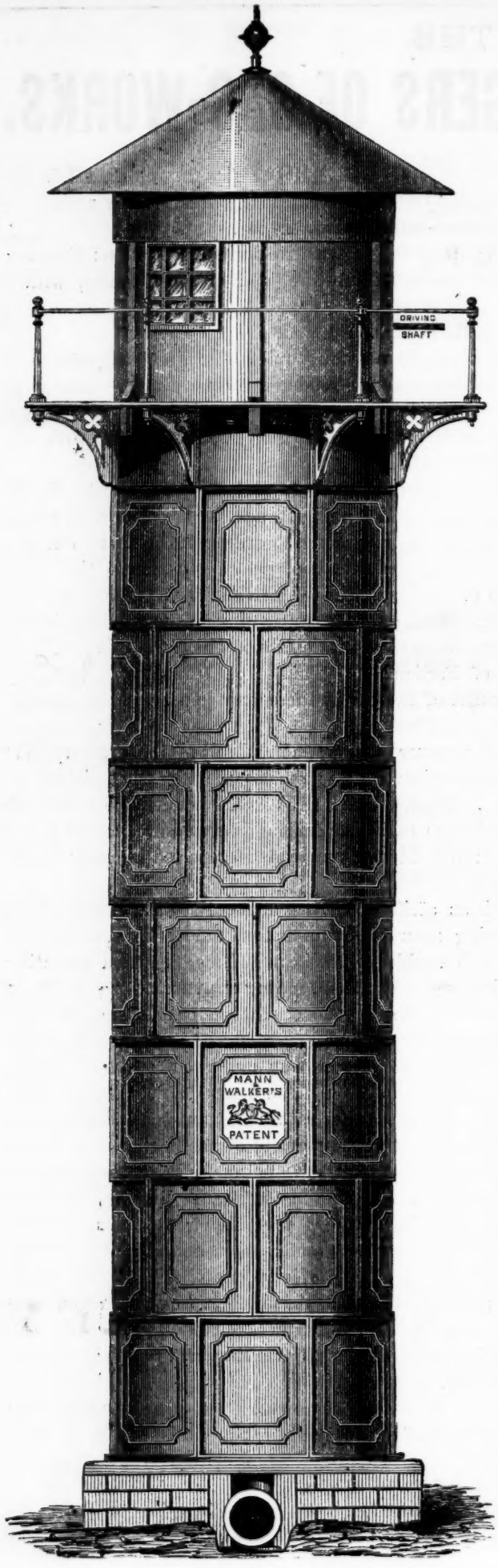
The DRY *Meter* is really NO METER at all; it is an aëriform engine, and only to the extent of the number of the revolutions made by the engine being recorded by an index, can it be considered a measure. The diaphragms, as they are called, are two double bellows coupled together, and actuating through the intervention of rods and cranks, the valves necessary for changing the current of gas to and from the bellows in its way through the engine. It will be seen at once, that in considering the Dry (so called) Meter thus, that the principle of construction is wrong, and no amount of ingenuity expended in arrangement or care in manufacture can convert a pair of bellows into an absolute positive unvarying measure. The leather stiffens in some cases, and so the bellows or diaphragms do not become fully inflated, hence the action is against the consumer; in other cases the leather becomes more flexible, the indications then are against the Company; further, in most cases the porosity of the leather is such that small quantities of gas are allowed to pass without any movement of the engine. The valves, too, are another source of weakness; by wear and by the deposit of oil and other matter on the faces, the action of the instrument is affected. Thus it will be seen that while the Common Wet Meter varies, its variation is limited to 5 per cent., but that the variation of the Dry (so called) Meter is unlimited, and may vary 50 per cent. or more. Instead of it being "a remedy" then "for all the defects of the Wet Meter," it cannot be relied on at all as a measure, and its complicated mechanism is such, that while a considerable expense is thrown upon the Company, the consumers are annoyed by the frequent changes required. The WARNER & COWAN Meter, then, is the only simple, stable, efficient, unvarying, and perfectly reliable Meter under every change and variation of the gas supply.

Makers of Dry Meters only will, no doubt, object to the above remarks, but cannot successfully controvert them. Those who, like ourselves, make both Wet and Dry Meters are better able to state the facts, and our position, as one of the largest manufacturers of Dry Meters, will protect us from any charge of prejudice.

Gentlemen, yours respectfully,

W. & B. COWAN.

London and Edinburgh.



C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the important results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us. C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

J. EDMUNDSON & CO.,
19, GREAT GEORGE STREET, WESTMINSTER,
LONDON, S.W.,
MANUFACTURERS OF EVERY DESCRIPTION OF
GAS APPARATUS.
CONTRACTORS FOR THE
ERECTION OF GAS-WORKS, GAS-FITTINGS, &c.,
FOR TOWNS, COUNTRY MANSIONS, &c.
Estimates given free of Charge.

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GAS ENGINEERS,
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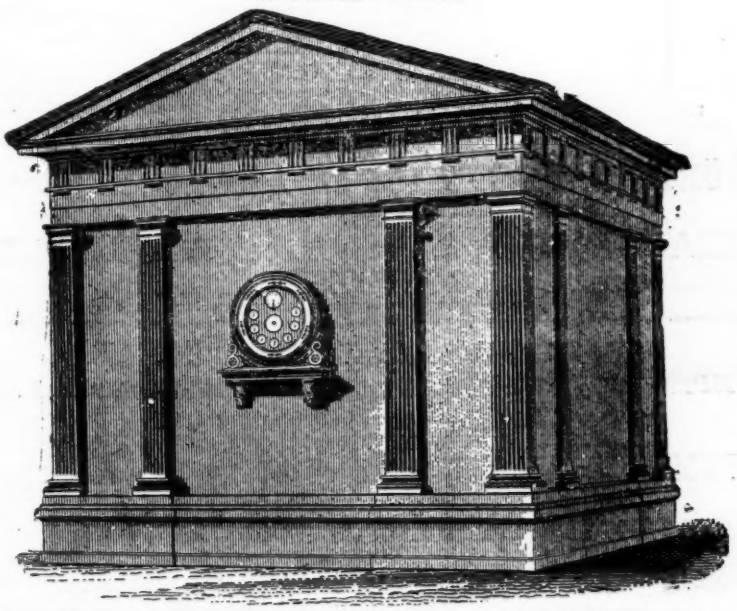
MANUFACTURERS OF
WET & DRY CONSUMERS GAS-METERS,
OF THE HIGHEST EXCELLENCE ONLY;
ALSO LICENSEES AND MANUFACTURERS OF
WARNER & COWAN'S PATENT SELF-REGULATING GAS-METERS;
ROUND STATION-METERS,
ON CAST-IRON STANDS.



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WITH PLANED JOINTS.
GOVERNORS, GAUGES, INDICATORS, MAIN COCKS, &c.
GAS COOKING APPARATUS.
Home and Foreign Orders promptly attended to.
All Sizes of CONSUMERS METERS, STATION-METERS, and GOVERNORS generally in Stock.
Orders almost invariably despatched on the day of receipt.
TERMS, &c., ON APPLICATION.

JAMES OAKES & CO.,
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CITY ROAD, LONDON, N.,
Keep in London and at their works large stocks of PIPES and CONNEXIONS (1½ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
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NEAR NEWCASTLE-UPON-TYNE,
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CLAY RETORTS, FIRE-BRICKS, AND EVERY DESCRIPTION OF FIRE-CLAY GOODS

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MANUFACTURERS OF
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INTERNATIONAL EXHIBITION, 1862.
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PRIZE MEDAL
For excellence of Fire-Clay Gas Retorts, and
"HONOURABLE MENTION" for
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WOOD PURIFIER SIEVES,
Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.
MIDLAND IRON-WORKS,
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CATOPTRIC
LAMPS.
The NEW PATTERN
Is now placed throughout
CHEAPSIDE.
For Terms of Licence to Use and Manufacture, apply to
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ALBERT GAS COAL.

THE DERBYSHIRE
SILKSTONE COAL COMPANY,
LIMITED,
CAN OFFER A
GAS COAL
Of superior quality, delivered at any station in England and Wales.

Purified gas per ton of coal in cubic feet (average)	10,775
Weight of coke in lbs. per ton of coal	1,465

ANALYSIS AND PRICES ON APPLICATION TO
Mr. EDMUND TAYLOR, Secretary,
ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

TROTTER, HAINES, & CORBETT,
BRETTELL'S ESTATE
FIRE CLAY & BRICK WORKS,
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Manufacturers of GAS-RETORTS, GLASS-HOUSE FURNACE & BLAST-FURNACE BRICKS LUMPS, TILES, and every description of FIRE-BRICK.
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BEST GLASS-HOUSE POT and CRUCIBLE CLAYS.
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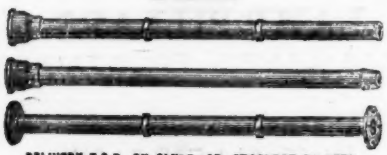
GAS-RETORTS, GLASS-HOUSE FURNACE,
BLAST-FURNACE, TANK BRICKS, LUMPS, TILES,
And Every Description of Best Fire-Bricks.

GAS AND WATER PIPES.
WILLIAM MACLEOD & CO.,
18 & 20, ALSTON STREET, GLASGOW.
CAST-IRON GAS AND WATER PIPES.



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MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS,
STEEL OF ALL DESCRIPTIONS,
SCREW STOCKS, TAPS, AND DIES, SPANNERS,
RATCHET BRACES, LIFTING-JACKS,
ANVILS, VICES,
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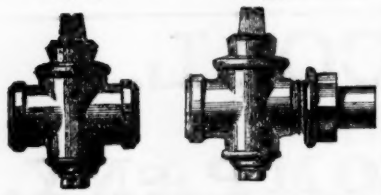
LAMBERT'S
CAST-IRON GAS-MAIN COCKS,
WITH PATENT WHITE METAL PLUGS.

TRADE (L) MARK.

No. 758. No. 759.



The bodies of these Taps are made of iron, black or galvanized, and the plugs of patent metal. They are warranted not to set fast or corrode, as do Iron or Brass Cocks; will always work easily; are strong, well made, durable; of little or no intrinsic value, and therefore not likely to be stolen; and the prices as stated below are (especially upon the larger sizes) fully 50 per cent. less than Brass Cocks.

	½	¾	1	1¼	1½	2-inch.
No. 758, with inside screws for iron pipe, black	2/0	3/0	4/4	6/6	7/6	12/0 each.
No. 759, with union on one end screwed inside for iron pipe, black	2/9	3/10	5/4	8/0	9/0	15/6 each.
Nos. 758 and 759, galvanized	0/3	0/4	0/6	0/8	0/10	1/4 extra.

MANUFACTORY:
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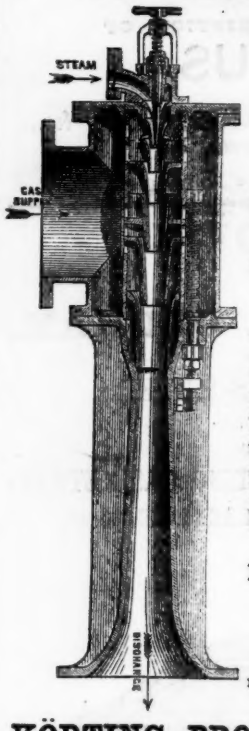
Steam-Jet Engineers,
7 and 17, LANCASTER AVENUE,
MANCHESTER.
Germany: Cellerstr. 35, Hannover. Austria: Kolring., Pestalozzigasse 6, Vienna
France: 11, Rue Louis-le-Grand, Paris. U. S.: 1645, N. 10th St., Philadelphia.



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STEAM-JET GAS-EXHAUSTER.
IMPROVED CLELAND'S PATENT.
Small Cost—Compactness—Perfectly Self-Acting—
Self-Regulating—Self-Cleansing—No Steam-Engine—No Attention—
No Extra Room Required—No Wear and Tear—No Noise—
No Oscillation in Vacuum, or Back Pressure.

UPWARDS OF 200 IN USE.
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Liverpool Gas Co.	Birmingham Gas-Works.	Dartford Gas Co.
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Horsham Gas Co.	Brentford Gas-Works.	Harrogate Gas Co.
Epsom and Ewell Gas Co.	Burnley Gas-Works.	Hertford Gas Co.
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SOLE LICENSEES FOR
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Combining small cost and thorough efficiency, with absence of any mechanical means and necessity of renewing the scrubbing material.

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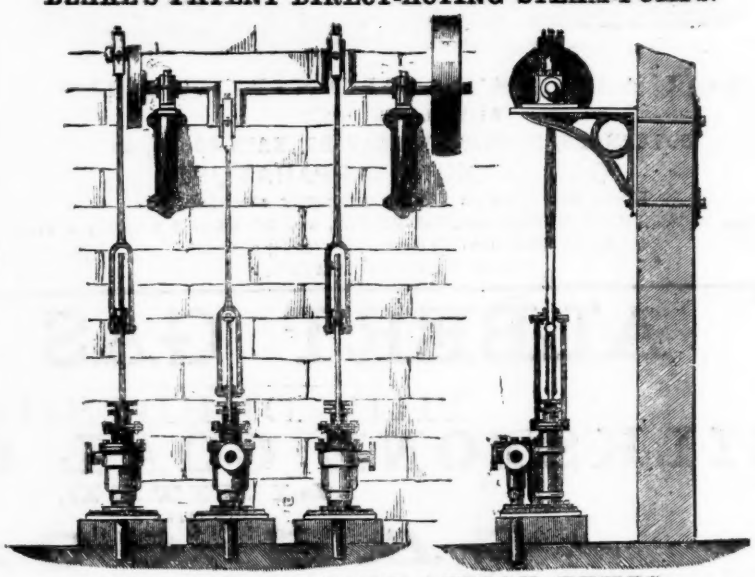

IMPROVED DOUBLE-ACTION PUMPS.
For Water. For Tar. For Ammoniacal Liquor.

This illustration shows an arrangement of three (No. 179) Improved Double-Action Pumps driven from the same crank-shaft, as frequently supplied for use in Gas and Chemical Works. The suction and discharge pipes can be arranged for drawing from and delivering in any required direction.

These Pumps have been supplied to nearly all the large Gas Companies and Chemical Works, both for Pumping Water, Tar, and Ammoniacal Liquor.

GAS SYPHON PUMPS, IN COPPER OR SHEET IRON, ALWAYS IN STOCK.
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LOTHIAN'S CANNEL
Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

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Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL
Yields 13,320 cubic feet of 32·5-candle gas per ton.
Prices and full Analyses on application.

GAS COAL.
POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.
One ton yields 12¼ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.
For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

HEBBURN MAIN GAS COALS.

Cubic feet of Gas yielded per ton . . .	10,050
Illuminating power in sperm candles . .	15·4
Yield of coke per ton of good quality . .	13¾ cwts.

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The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.
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COPPA COLLIERY, MOLD,
CANNEL FOR GAS-MAKING PURPOSES.
This Cannel produces in actual working, in iron retorts, 9300 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·5-candle gas.
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Delivery per Rail to any Part.

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PREVENTS WASTE OF GAS FROM RETORTS;
SAVES CLAY RETORTS FROM DESTRUCTION BY FIRE;
GREATLY ECONOMIZES THE USE OF FIRE-BRICKS;
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BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
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REAL OLD SILKSTONE GAS COAL.

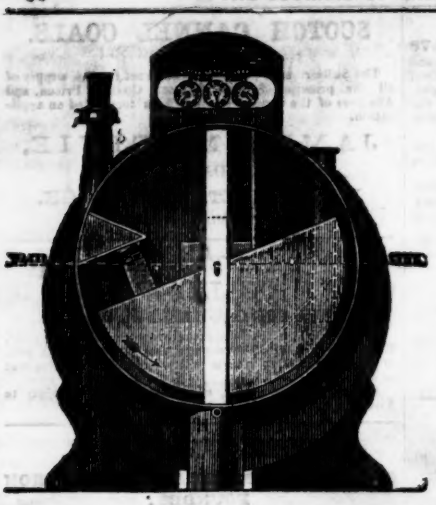
JAMES PATERSON, Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—
"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces 12,240 cubic feet of 16·66 candle gas."
The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.
PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

MESSRS. NEWTON, CHAMBERS, & CO.,
THORNCLIFFE IRON-WORKS AND COLLIERIES,
NEAR SHEFFIELD,
STRONGLY RECOMMEND A TRIAL OF THEIR
CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—
(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.
Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.
These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.
APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.



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UNVARYING WATER-LINE GAS-METER.

(SANDERS AND DONOVAN'S PATENT.)

"Unquestionably the best Water Gas-Meter now in use."—THOS. G. BARLOW, C.E.

Over 90,000 in action.

MANUFACTURERS

THE GAS-METER COMPANY,

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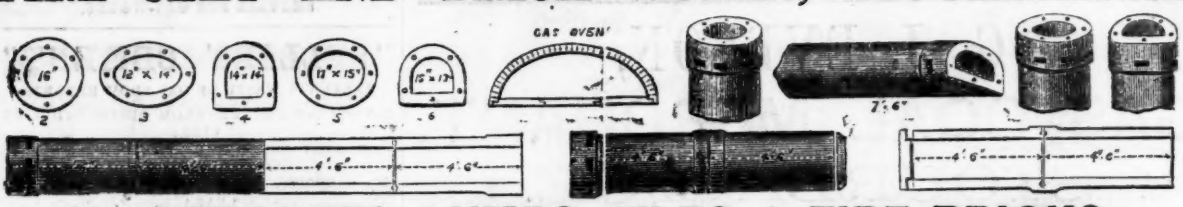
WITH

Branch Manufactories at DUBLIN and OLDHAM.

HARRIS & PEARSON,

FIRE-CLAY AND BRICK WORKS, STOURBRIDGE.



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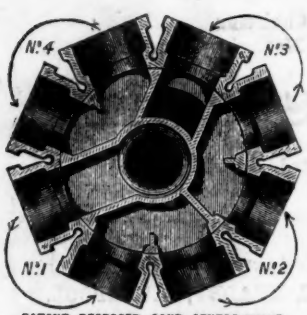
A LARGE ASSORTMENT OF GAS-RETORTS IN STOCK.

STOCK FOR EXPORT READY AT THE WORKS, AND AT ELLESMERE PORT.



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Sectional Plan.

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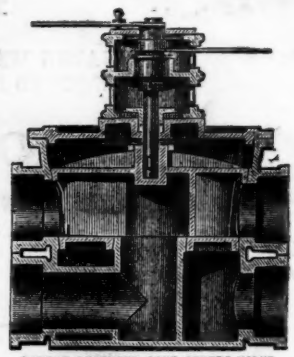
RECESSED CONE CENTRE-VALVES,

Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Elevation.

LONDON OFFICE: 106, CANNON STREET.

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PATENTEES and MANUFACTURERS of the ONLY GOOD MERCURIAL GAS REGULATOR

Invite the attention of Gas Companies and the Trade generally to their Improved GAS-METERS, which they warrant equal to any in Quality, Workmanship, and Simplicity of Construction, and the only Meters from which Gas cannot be obtained without being duly registered.

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